TIDAL WAVE

NOVAMETRIX CAPNOGRAPHY

HAND-HELD CAPNOGRAPHY

Service Manual

Model 615

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CE 0086

About This Manual

This manual is intended for use by technical personnel for servicing the Model 615. Refer to the Model 615 User's Manual (Cat. No. 9425-23) for detailed information on normal operation.

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Section 1 *General Description*

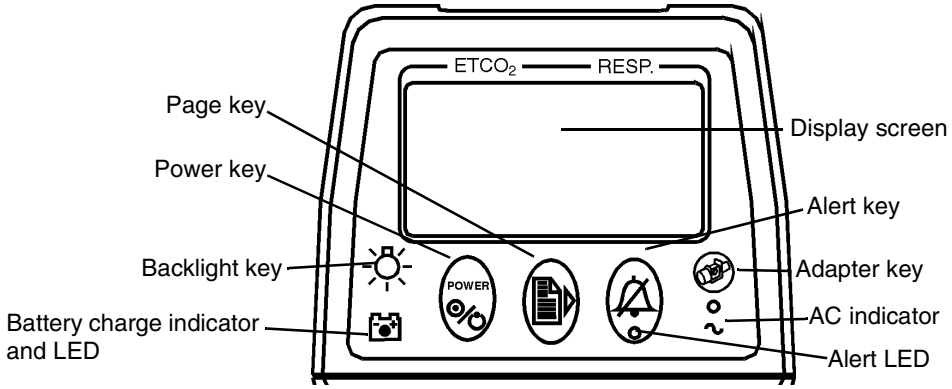
1.1 Indication for use

The Model 615 hand-held, portable Capnograph is intended to be used for monitoring end tidal CO_2 and respiration rate in monitoring environments such as ventilatory support, emergency and anesthesia. The Model 615 incorporates a miniature vacuum pump to draw expired respiratory gases through the CAPNOSTAT® CO_2 Sensor using a sampling airway adapter and nasal cannula. The Model 615 is designed to monitor adult, pediatric and neonatal patients and is not intended for any other purpose.

NOTE

Components of this product and its associated accessories which have patient contact are free of latex.

1.2 Keypanel Controls and Indicators



POWER	Switches power on/off.
	Displays, Capnogram, $EtCO_2$ trend or respiration rate trend. Press and hold to enter the PRINT SELECTION menu.
	Sets 2 minute silence and displays the SET ALERTS menu. Press and hold for 3 seconds to disable audible alerts. Press and hold again to cancel. The Alert Key LED: Steady yellow: audio silenced for 2 min., no alert in progress. Flashing yellow: audio off , no alert in progress. Flashing red and yellow: alert in progress; audio is off or 2 minute silence.

	Press to set adapter type. Press and hold for 4 seconds to zero adapter.
	Press to turn backlight on/off, or press and hold to adjust contrast.

INDICATORS

	Illuminates when on battery power. Green; battery is fully charged, slow flashing yellow; battery power is low (approximately 20 minutes of operation), Fast flashing red; battery is exhausted (approximately 5 minutes of operation).
	Green when the monitor is connected to an AC power source.

ICONS

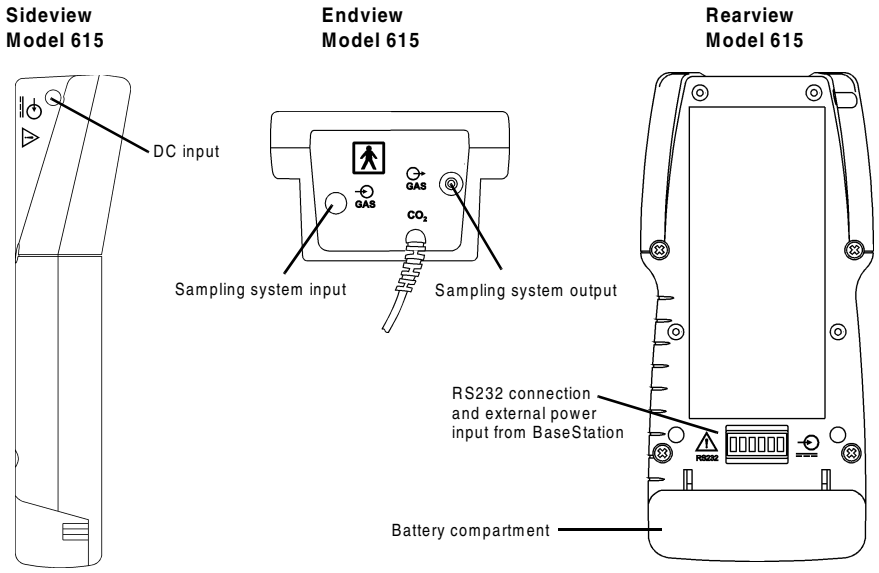
	Audible alerts permanently silenced.
	Audible alert silenced for two minutes.
	Alert limits disabled.
	Indicates adapter key.
	Time/Date Icon
	Indicates backlight key.
	Displayed beside any Trend screen.
	Displayed when performing an adapter zero and the sensor is not at operating temperature.
	Displayed when performing an adapter zero and breaths are detected.
	Displayed when CAPNOSTAT® CO_2 sensor is attached to patient and breaths are detected.

SYMBOLS

	Patient isolation: Identifies connection as type BF
	Attention: Consult manual for detailed information

GAS	Sampling System: Gas output
GAS	Sampling System: Gas input
⎓	DC input. Connect external power supply to this port. Use only Novametrix external power supply, Catalog number 9220-10.
♻	Recyclable item. This symbol is found on the internal battery and should not concern the common user. Refer to qualified service personnel when battery replacement is required.

1.3 Connections and Labelin



1.4 Principle of operation

The Model 615 uses the CAPNOSTAT® CO_2 sensor to measure CO_2 by using the infrared absorbtion technique, which has endured and evolved in the clinical setting for over two decades and remains the most popular and versatile technique today.

The principle is based on the fact that CO_2 molecules absorb infrared (IR) light energy of specific wavelengths, with the amount of energy absorbed being directly related to the CO_2 concentration. When an IR beam is passed through a gas sample containing CO_2, the electronic signal from the photodetector (which measures the remaining light energy) can be obtained. This signal is then compared to the energy of the IR source and calibrated to accurately reflect C $_2$ concentration in the sample. To calibrate, the photodetector's response to a known concentration of CO_2 is stored at the factory in the monitor's memory. A reference channel accounts for optical changes in the sensor, allowing the system to remain in calibration without user intervention.

Section 2 Safety

For maximum patient and operator safety, you must follow the following warnings and cautions.

WARNINGS

Indicates a potentially harmful condition that can lead to personal injury.

- **Explosion Hazard:** *DO NOT* use Model 615 in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- **Electrical Shock Hazard:** Always turn Model 615 off and remove any external devices before cleaning it. Refer servicing to qualified service personnel.
- **Failure of Operation:** If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- Do not operate Model 615 if it appears to have been dropped or damaged.
- Do not operate Model 615 or its accessories when it is wet due to spills or condensation.
- Never sterilize or immerse the monitor, sensor or accessories in liquids.
- The monitor does not alert for NO RESPIRATION if the airway adapter is removed from the CAPNOSTAT® CO_2 sensor.
- Verify the “No Resp Timer” setting prior to use.
- Do not position any sensor cable in a way that may cause entanglement or strangulation.
- The Model 615 is not intended to be used as a primary diagnostic apnea monitor and/or recording device.
- The external battery charger should NOT be used to recharge the battery near or in close proximity to patients and/or other medical equipment in operation. It is intended for use in service areas only (i.e. nurses station, biomed lab, etc.).
- Connection of an external device (e.g. printer or computer) to the RS232 serial port on the BaseStation may compromise patient safety.

CAUTIONS

Indicates a condition that may lead to equipment damage or malfunction.

- Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.
- Use only an external power supply approved by Novametrix for use with this device. Use of any other power supply may damage the Model 615 and void the warranty.
- Do not operate Model 615 or its accessories when it is wet due to spills or condensation.
- Do not operate Model 615 if it appears to have been dropped or damaged.
- Keep Model 615 and its accessories clean.
- Inspect the integrity of the Model 615 and its accessories prior to use.
- Never sterilize or immerse the monitor, sensor or accessories in liquids.
- Do not sterilize or immerse sensors except as directed in this manual.
- Do not apply excessive tension to any sensor cable or pneumatic tubing.
- Do not store the monitor or sensors at temperatures less than 14°F (-10°C) or above 131°F (55°C).
- Do not operate the monitor or sensors at temperatures below 50°F (10°C) or above 104°F (40°C).

- If a Single Patient Use Sampling Adapter becomes occluded, replace and discard the adapter.
- It is recommended that the CAPNOSTAT® CO_2 sensor be removed from the circuit whenever an aerosolized medication is delivered. This is due to the increased viscosity of the medications which may contaminate the sensor windows, causing the sensor to fail prematurely.
- Where electromagnetic devices (i.e. electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electromagnetic fields up to 3V/m will not adversely affect system performance.
- Refer servicing to qualified personnel.

NOTES

Indicates points of particular interest or emphasis for more efficient or convenient operation.

- The Model 615 monitor is intended for operation with Novametrix Single Patient Use airway adapters.
- Operating the Model 615 below 50°F (10°C) will result in longer warm-up time and reduce battery life.
- Components of this product and its associated accessories which have patient contact are free of latex.
- Certain rebreathing circuits, or the presence of artifacts such as cardiogenic oscillations, may cause Model 615 to react to non-respiratory CO_2 fluctuations as if they were breaths. This condition affects only the RESP numerical displays; the capnogram display continues to provide an accurate picture of the CO_2 waveform.
- After the life cycle of our equipment and all accessories has been met, disposal of the equipment should be accomplished following the national requirements. Contact the local Novametrix representative for questions concerning disposal.

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Section 3 *Theory of Operation*

The Model 615 is a microprocessor based handheld instrument that measures the clinica parameters of CO_2 production and respiration rate (RR). The electronic theory of operation of the Model 615 is explained in detail in the subsections that follow.

3.1 Digital Control System

Refer to 2754-03 schematic sheet 1.

Embedded control for the system is provided by IC1, a Motorola MC68332 integrated microcontroller. In addition to a full 32-bit Central Processing Unit (CPU), this device also contains circuitry for system clock generation, peripheral chip select generation, data control, interrupt generation, a sophisticated timing coprocessor, synchronous serial communication and asynchronous serial communication. In general, functional signals are grouped together into ports, and each signal can be independently programmed by software to be its predefined port function or as discrete I/O. Additionally, the functionality for several ports (Port C, E and F) can be predefined by the state of the data bus on system power-up. A special “background mode” port allows the device to be controlled by an external source for system debugging and testing. Also integrated on-chip are several activity monitors, as well as a software watchdog to ensure proper device and system operation. Refer to table 1.

Table 1: CPU Port Functions

Port	**Defined Function**	**Functionality Control , Data Bus Control (Alt Functions: D pulled low)**
TPU 16 Channels	Timing Signal Generation	Each channel independently user programmable as TPU function or as Discrete I/O
QSM 4 Synchronous Serial Chip Selects & one asynchronous serial channel	Serial Communications Port: QSPI: Queued Serial Peripheral Interface SCI: Serial Communications Interface	QSPI chip selects independently user programmable, can be used as Discrete I/O or decoded to create up to 16 chip selects. SCI transmit can be programmed as Discrete I/O
Background Mode	System debugging	Allows an appropriate external device to control the microprocessor and system

Table 1: CPU Port Functions

C	Chip Selects	D0: CSBOOT* data width, 8 or 16-bit D1: CS1*-CS3* or BR*,BG*,BGACK* D2: CS3*-CS5* or FC0-FC2 D3-D7: CS6*-CS10* or A19-A23
E	Bus Control	D8: Control Signals or discrete I/O
F	MODCK and Interrupts	D9: MODCK & IRQ or discrete I/O

The maximum operating frequency of the integrated processor is 20.97 MHz. The operating frequency is software selectable and generated by an internal VCO operating from Y1, a 32.768KHz watch crystal. The Timing Processor Unit (TPU) coprocessor of the MC68332 provides timing generation derived from the system clock. This feature is utilized to control the precise timing required for the acquisition of the end tidal carbon dioxide ($EtCO_2$) signals. The TPU is also use to generate the PWM (Pulse Width Modulation) control for the CAPNOSTAT® CO_2 sensor case and detector heaters, as well as to provide the frequency generation for the audio tones. See Tables 2 & 3.

Table 2: TPU Timing Generation for the $EtCO_2$ subsystem

Signal Name	Description	Function / Timing
CO2AZ	Auto Zero	Clears the sample/hold circuitry prior to data acquisition. Active high, 2.84 ms
CO2PWENB	Pulse Width Enable	Defines the active time for both phases of the bipolar source pulse, used for pulse width protection circuitry. Active high, 830 µs
SRCDRV0	Source Drive 0	First source drive signal. Active high, 405 µs
CS*/H	Current Sample/Hold	Enables circuitry for source current measurement. Sample is taken when SRCDRV0 is active. Low = sample, 270 µs, High = hold
SRCDRV1	Source Drive 1	Second source drive signal delayed for 30 microseconds after SRCDRV0 ends. Active high, 395 µs

Table 2: TPU Timing Generation for the $EtCO_2$ subsystem

SS*/H	Signal Sample/Hold	Enables circuitry for CO_2 and reference channel data acquisition. Low = sample, 270 µs, High = hold
CASEPWM	Case Heater PWM	PWM control for the case heater servo
DETPWM	Detector Heater PWM	PWM control for the detector heater servo
TONE	Audio Tone Generation	Variable frequency outputs to generate system audio
CASEOT	Case Heater Over Temperature	Case heater over temperature shut down
DETOT	Detector Heater OverTemperature	Detector heater over temperature shut down

Ferrite and L-C filters, 100pF capacitors, and 100 ohm resistors have been placed on selected microprocessor signals with fast rise and fall times (including timing, clock, and address and data lines) in order to help reduce and suppress the radiation of electromagnetic interference and decouple unwanted power supply noise. In addition, good EMI/EMC design techniques have been incorporated in the component layout and printed circuit board layout and manufacture.

Table 4 lists the chip select, control and discrete I/O functions for the *Model 615* system module. On power-up, Ports E and F are programmed as discrete inputs by pulling down their controlling data lines, DB8 and DB9. After power-up, the software sets up each pin function individually and performs a series of self tests to check the integrity of the system. The state of configuration inputs on Port E (TST*, CNFG0*, CNFG1*, and CNFG2) are read. These inputs allow the software to identify different operating states such as Test Mode, or different hardware configurations. After the initialization period is complete and all system functions have been set,

the LED output (PF0) toggles at a 1Hz rate switching transistor Q3 which drives the status LED D3, indicating that the system is ready for operation.

Table 3: Chip Select, Control and Discrete I/O

Port	Pin Functions	System Signal Name	I/O	Comments
C	D0 pulled low, D1-D7 pulled high, pins are chip select on power-up			
	CSBOOT*	ROMOE*	O	Program PROM chip select byte wide mode, (8-bits) D0 = LOW
	CS0* / PC0 / BR*	SRAMWR*	O	SRAM write enable
	CS1*/ PC1 / BG*	AUD_CS*	O	Audio attenuation control chip select
	CS2* / PC2 / BGACK*	SRAMRD*	O	SRAM read enable, byte mode
	CS3* / PC3 / FC0	ROMWR*	O	FLASH PROM Write Enable, Byte Mode
	CS4* / PC4 / FC1	DISPCS1*	O	LCD chip select #1
	CS5* / PC5 / FC2	DISPCS2*	O	LCD chip select #2
	CS6* / PC6 / A19	LATCH1_CS*	O	System control signals latch 1 chip select
	CS7* / PC7 / A20	LATCH2_CS*	O	System control signals latch 2 chip select
	CS8* / PC8 / A21	ROMWREN	O	Port C discrete output, prevents unintentional writes to FLASH EPROM. This signal must be asserted before ROMWR* in order to overwrite the flash.
	CS9* / PC9 / A22	PROFILE*	O	Enables software profiling data output latch
	CS10* / ECLK / A23	ECLK	O	Enable clock for the liquid crystal display

Table 3: Chip Select, Control and Discrete I/O

E	D8 pulled low, discrete I/O on power-up			
	DSACK0* / Port E0	TST*	I	Initiate system TEST if low
	DSACK1* / Port E1	DS1*	I	Data and size acknowledge 1*
	AVC* / Port E2	CNFG0*	I	Configuration switch 0
	RMC* / Port E3	CNFG1*	I	Configuration switch 1
	DS* / Port E4	DS*	O	Data strobe
	AS* / Port E5	AS*	O	Address strobe
	SIZ0* / Port E6	CNFG2*	I	Configuration switch 2
	SIZ1* / Port E7	SLP*	I	Not used in Model 615
	R/W*	WR*	O	Data write strobe
F	D9 pulled low, discrete I/O on power-up			
	MODCK / Port F0	LED	O	LED CPU activity Indicator
	IRQ1* / Port F1	SW1	I	Keypanel switch 1 input
	IRQ2* / Port F2	SW2	I	Keypanel switch 2 input
	IRQ3* / Port F3	SW3	I	Keypanel switch 3 input
	IRQ4* / Port F4	SW4	I	Keypanel switch 4 input
	IRQ5* / Port F5	PWRKEY	I	Power key status input
	IRQ6* / Port F6	EXTDCIN	I	Indicates external AC mains power operation
	IRQ7* / Port F7	NMI	I	Non-maskable interrupt

Background Mode Debugging

External system debugging is possible by connecting an appropriate device (emulator or debugger) to header J401 and momentarily bring the BERR* (J401/2) low. This halts the bus activity and turns control of the system over to the external device. In this mode, internal MPU registers can be viewed and altered, special test features can be invoked and system memory can be read and written to.

System Memory

An 8-bit wide data path is used for FLASH PROM and SRAM transfers. Program code storage is contained in a 1-Meg 5V FLASH or EEPROM (IC2) device. The FLASH PROM is protected from unintentional overwrites of the program code by transistor Q1 and the ROMWREN signal.

The ROMWREN line must be high prior to writing new code into the FLASH devices. Nonvolatile data storage is contained in the 1-Meg SRAM (IC3). The SRAM is backed-up to retain it's contents by applying a voltage on VBACKUP generated by BT1 (a 3.0V lithium battery) when power is off or the battery is removed from the monitor. During the battery backup state, transistor Q2 keeps the CS1* control of the SRAM in the inactive state. This forces the data bus to a high impedance state, isolating the SRAM from the rest of the system. True nonvolatile storage for the bootstrap parameters for the CAPNOSTAT® CO_2 sensor are stored in a serial EEPROM (IC2) located on the Interface (2753) board.

Serial Communications

Refer to 2754-03 schematic sheet 6.

The on-chip (IC1) asynchronous serial communications interface (SCI) channel is contained in the MC68332. The signals are level shifted to standard RS232 levels by IC26 which is a Dual RS232 Communications Driver/Receiver. The transmitters in the RS232 level shifter are under software control to minimize the patient leakage current to the rear panel connector (J101 when communication is not active. The signal COMMPWR controls the transmitters operation and is derived from IC9 pin 14 (schematic sheet 2). The serial connection to external, non-patient contact devices is electrically isolated from the patient through the CAPNOSTAT® CO_2 sensor airway adapter. This connector, J101 is located on the rear panel and is designed to interface with external devices (i.e. computer, printer) when placed in a base station which contains the mating connector. In addition there is a 4 pin connector (J403) available for test and service which offers an internal connection to the serial communications at a TTL level. The data signals ASRxD and ASTxD are logic level signals and are diode protected against over voltage by D22 and D23 should IC26 breakdown from ESD (schematic page 6). Refer to Table 5 for the pinout and signals of serial interface connector J101.

Table 4: Power/Communications 6-pin modular connector J101 located on the rear panel.

Pin Number	Signal	Function
1	RxD	Internal MC68332 UART Receive, RS232 Signal, Level Shifted
2	TxD	Internal MC68332 UART Transmit, RS232 Signal, Level Shifted
3	DGND	Digital Ground
4	DGND	Digital Ground
5		
6	+VCHG	External DC input supply to power unit and battery charger

User Interface Control Circuitry

Refer to 2754-03 schematic sheet 2.

The user interface features a 64 row by 128 column Liquid Crystal Display (LCD) module with an LED backlight. A 5-switch membrane keypanel is provided for operator entry. The use interface also contains three LED's which represent various system conditions.

Control of the user interface is provided by the LATCH1_CS* chip select signal together with the Port F input signals from the microprocessor. SW1-SW4 are inputs which read in the

present state of the membrane keys. Depressing a key causes the signal line to be pulled low in contrast to its normally high state. IC9 provides a latched output for controlling the status LED's. The LCD backlight is a series of LED's which are driven by a 5.12kHz clock signal in order to lower the LCD backlight power requirement and is activated by the backlight membrane key. The LITE_CLK signal is a 5.12kHz logic level signal generated by IC7 (sheet 7) which modulates the LED backlight through FET switch Q4 (BKLGHT_OUT) when asserted by IC10 (BACKLIGHT). This signal is capacitively coupled by C42 in order to prevent the backlight from remaining on in the event of a system failure.

Contrast control for the LCD is provided by DAC IC33 (sheet 6) and amplifier IC34A and transistor Q18 (schematic sheet 6). When the CPU detects a press and hold of the backlight membrane key, the CPU sends a digital ramp input to the DAC which causes the output to change accordingly. Inverting amplifier IC34A controls the base current into transistor Q18, which changes the level of the display contrast voltage, VDISP.

Refer to schematic sheet 6.

An audio frequency tone is generated by the TPU (Time Processor Unit) of the MC68332 (TONE). This signal is fed into the divider network consisting of R183 and IC32. IC32 is a 10k ohm E^2 potentiometer whose value (when written to under software control) provides a means for attenuating the signal under CPU control. From the divider output the signal is amplified by IC34B and Q17 which drives the system speaker (LS1) to produce system audio. The AUD_EN line from IC9 controls Q19, when high the input to IC34B is grounded thus muting the audio.

Real Time Clock, Power on RESET Generation and Glue Logic

Refer to 2754-03 schematic sheets 1 and 2.

Time-keeping for date and time stamping of patient trend information is provided by IC8. This device contains a built-in crystal for precise time and date measurement. In the absence of digital power, the time keeping function is maintained by the battery backed supply, VBACKUP which is generated by the 3V lithium backup battery (BT1).

On power-up, the system is forced into a "Reset" state by IC4 (sheet 1). When the suppl voltage VDD, approaches 1V, the SRST* line is asserted to prevent undefined operation. IC4 also provides supervision over the VDD logic supply. If the logic supply falls below 4.55V ±120mV then IC4 generates a reset condition until the supply returns to a safe level. Inverter IC5 is used to generate the active high RESET signal.

The *Model 615* makes use of the high level of integration offered by the MC68332. Therefore the glue logic required is a minimum. Chip selection for the serial peripherals is provided by decoding the queued serial module (QSM) (PCS0-PCS3) of the microprocessor IC1 (sheet 1 on schematic) using decoder IC12 (sheet 2) while parallel interface peripherals are selected by the internal chip select registers of Port C (BOOTCS* and CS0*:CS10*). Latch IC10 is used to control the saturation analog signal processing, the LCD backlight, the sidestream sampling pump, and to power the monitor off.

3.2 CO_2 System Analog Subsections

CO_2 Source Drive

Refer to 2754-03 schematic page 3 and Table 2 of this document.

The source drive circuitry is designed to drive the source with a bipolar signal to prevent the migration of charges within the source that may result from unidirectional electrical fields. The

resistance of the source is monitored constantly to ensure the integrity of the system by sampling the current through the source while it is active.

The SRCDRV0 and SRCDRV1 lines are used to control the bipolar signal that drives the source. The SRCDRV0 signal goes high as soon as the CO2AZ (Auto Zero) line goes low and the CO2PWENB (Pulse Width Enable) line goes high. The duration of SRCDRV0 is 405 us (microseconds), and drives the source in the positive direction. The SRCDRV1 line drives the source with an opposite polarity signal when high for the same duration. There is a 30 us delay from the time the SRCDRV0 line goes low to when the SCRDRV1 line goes high. This delay is to prevent the possibility of both SRCDRV0 and SRCDRV1 being active at the same time, thus creating a low impedance path between the two supplies (power supply shoot-through). SRCDRV1 steers current through the source in an opposite direction from SRCDRV0.

When SRCDRV0 and CO2INH (Inhibit) are high, the output of MOSFET Driver IC13A pin 7 will go low. This turns the P-Channel half of MOSFET Q5 on. At the same time, the output of MOSFET Driver IC14B pin 6 will be high biasing on the N-Channel half of MOSFET Q6 on. With both Q5B P-Channel and Q6A N-Channel on, current will flow from +VSRC through Q5B to the positive source terminal, then back from the source negative terminal through Q6A, through R97 to -VSRC. When SRCDRV0 returns low, both Q5B and Q6A are turned off and no current flows through the source. After the 30 us delay, SRCDRV1 will go high. The output of IC14A pin 8 will go high, biasing the N-Channel section of MOSFET Q5 on. The output of IC13B pin 5 will go low, turning the P-Channel of Q6 on. Current will now flow from +VSRC through Q6B to the source negative terminal, back from the source positive terminal through Q5A and R97 to -VSRC. Current will cease to flow when SRCDRV1 goes low. The bridge circuit of Q5 and Q6 in effect switches the polarity of the drive signal of the source between +VSRC and -VSRC. CO2PWENB also falls with the falling edge of SCRDRV1, signaling the end of source activity.

When current flows through the source, it will also flow through current sensing resistor R97, creating a differential voltage proportional to the source current:

$$V_{SRC} = (V_{SR} / R_{SR}) * R_S * A_{V(DA)} \text{ where:}$$

V_{SRC} =voltage out of difference amplifier proportional to current through the source element = 24V +/- 0.625V

V_{SR} =differential voltage across the source element

R_{SR} =resistance of the source element

R_S=resistance of the current sensing resistor = 1 ohm

$A_{V(DA)}$=difference amplifier gain = 5

V_{SRC} =[120 (Volts*Ohms) / $_{SR}$]

The voltage signal out of difference amplifier IC15B is level shifted through C52 and fed to the sample and hold IC16A via buffer amplifier IC15A. A low level on the CS*/H (Current Sample and Hold) signal allows the source current signal to be sampled. On the rising edge of CS*/H, the present voltage level of the source current signal is held and appears at the input to channel A2 of the Analog to Digital Converter IC6 (sheet 2 on schematic) for processing by the MPU. When CO2AZ is high, the input to the sample and hold of IC16A is grounded to discharge any residual charge that may be on C52.

In order to prevent the source from being driven until the system is up and ready, there i protection circuitry that inhibits the source drive until enabled. During system power-up, the RESET line keeps Q7 on. This causes the CO2INH line to be brought low, preventing source pulses by pulling down SRCDRV0 and SCRDRV1 through D6. Protection circuitry also guards against extended pulse width as well as shortened duty cycle. On the rising edge of CO2PWENB, the trip point of IC17B is exceeded, allowing C55 to charge through R100. If the

SRCDRV signals do not turn the Source Pulse off within 200 us after the 830 us pulse period, the trip point for IC17A will be exceeded, pulling the CO2INH line low turning the Pulse off. After the CO2PWENB signal returns low, capacitor C57 discharges through R101, keeping the output of comparator IC17B at the voltage acquired by C55. After approximately 10.4 ms, C57 will have discharged below the comparator trip point. The comparator output goes low, discharging C55 and the circuit is ready for the next source pulse cycle.

CAPNOSTAT® CO_2 sensor Case and Detector Heater Control

Refer to 2754-03 schematic sheet 4.

The temperature of the system directly affects its ability to accurately measure CO_2 and therefore must be precisely maintained at a controlled value. Two separate heaters and control circuitry are used; one regulates the temperature of the detectors for the CO_2 data and reference channels; the other regulates the temperature of the transducer case (and loosely maintains the temperature of the airway adapter). While the purpose of the detector heater is to keep the detectors' sensitivity to infrared radiation constant, the function of the case heater is to keep condensation from forming on the airway windows by elevating the window temperature above the ambient airway temperature. Both heaters use an efficient pulse-width modulation scheme designed to decrease power consumption, with the PWM timing generated by the TPU under microprocessor control. This control loop is run by the CPU which does the calculations and passes the duty cycle to the TPU. For the purpose of describing the regulation loop, the case heater circuitry will be considered. The detector and case heater circuitry are identical.

Inside the CAPNOSTAT® CO_2 sensor, a sensing thermistor is thermally connected to the heater module. Initially, the CAPNOSTAT® CO_2 sensor is at the ambient temperature and the resistance of the thermistor is large. A small current flows through the signal path “CASETHERM” and only a small voltage is developed across R117. The microprocessor programs the TPU to allow a maximum duty cycle of 90% to power the PWM heater circuitry. This causes the heater control MOSFET Q9B to be pulsed on and off with a duty cycle that is under direct control of the program software. As the heater warms up the case, the thermistor's resistance decreases, raising the voltage appearing at the input of the control loop. As described below, the MPU looks at this voltage and decreases the duty cycle of the PWM control circuitry, gradually reducing the power output into the heater. When the desired temperature set point is reached, a balance is struck between the energy delivered to the system and the heat flow out of the system.

The case thermistor is sensed by amplifier IC18A pin 3. The difference between the signal at the non-inverting input and the reference appearing at the inverting terminal generates an error voltage proportional to the sensed temperature at the amplifier's output:

$$e_o\ (V) = [83.133V / (R_{th}+3.32K)] - 10.2V \text{ where:}$$

e_o = amplifier output voltage

R_{th} = resistance of the thermistor = 4.36933K at 45°C

$$\text{Temp } (°C) = 4.1288\ (°C/V) * e_{o\ (T)}\ V + 41.7321°C$$

where e_o = amplifier output voltage at temperature T

This error voltage is low pass filtered by amplifier IC20A, sent to the ADC (IC6) and processed by the CPU to regulate the output pulses from the TPU. The TPU PWM signal is buffered by MOSFET Driver IC19A and capacitively coupled to the gate of the heater drive MOSFET, Q9B. Capacitive coupling the signal prevents a system fault that would allow the PWM to be stuck at a level that would cause too high of a heater output. In the absence of a pulse, the gate drive

will be pulled high, disabling the output to the heater. The pulsed voltage signal out of the MOSFET is filtered by D12, L6, C68 and C69 to produce a DC output level for the heater. Since the TPU generated PWM signal is based on the system clock, it is synchronized with the generation of the source pulse timing. This minimizes the effect of any random disturbance caused by the heater circuit on the detection of the CO_2 data and reference signals.

The error voltage out of amplifier IC18A also appears at the temperature watchdog comparator IC17C. If the error voltage reaches a voltage equivalent to 56 degrees Celsius, the comparator trips, turning Q10 off. The gate of MOSFET Q9A is pulled high by R116, which turns it off and VHTR is prevented from reaching the source of transistor Q9B. The temperature of the sensor is also monitored by the MPU which will disable the heater when a temperature of 50 degrees Celsius is exceeded. To shut off the heater, the MPU asserts the CASEOT signal, turning Q11 on which turns Q10 and Q9A off.

CO_2 Input Signal Path

Refer to 2754-03 schematic sheet 5.

The signals from the sensor "CO2DATAIN" (CO_2 Data) and "CO2REFIN" (reference signal) have similar signal paths. The CO2DATAIN passes through a high pass filter with a gain of 3.8 consisting of C80, R148 and buffer amplifier IC21B. The signal is fed to a Butterworth low pass filter IC21A and associated components. This filter has a gain of 2 with a corner frequency of 1.5 KHz. The output from the low pass filter is fed to a 12-bit digital to analog converter IC22. The signal, "CO2DIN" comes into the reference of the DAC, which acts as a programmable gain stage followed internally by an amplifier with a fixed gain of 2. Here under processor control the signal's gain is adjusted to an acceptable level for conversion. The gain setting is adjusted using the digitized signal out of the A/D Converter (IC6) as part of the feedback loop. Similarly, "CO2REFIN" is conditioned by high pass filter IC21D with a gain of 1.75 and low pass filter IC21C with a gain of 2. The equivalent fixed gains for the two input signals are not equal in order to compensate for differences in the output signal levels of the infra-red detectors in the sensor.

The output from IC22 is buffered by IC24A and AC coupled through C91 to IC23A. The "CO2DATAIN" signal received from the sensor is ac coupled prior to the initial gain stage and high pass filtered to remove any DC bias by C80. Prior to sampling CO_2 signal, the "CO2AZ" (Auto Zero) pulse biases Q15 on, causing any residual charge on C91 to discharge to ground. At the start of the source pulse, the "CO2AZ" pulse goes low and the CO_2 signal from the sensor is attained, and appears at the input of the sample and hold amplifier, IC16B. Near the end of the source pulse, the "SS*/H" (Signal Sample and Hold) goes low and the peak signal is acquired on the internal sample and hold capacitor. "SS*/H" returns high at the end of the cycle, and the CO_2 signal on the sample capacitor is held at the peak value. The signal then passes through a low pass filter of R159 and C92 before being converted by the ADC into digital data and analyzed by the processor. The signal "CO2REFIN" follows an identical zeroing and acquisition path.

CAPNOSTAT® CO_2 sensor Interface

Refer to schematics 2754-03 sheet 5 and 2753-03 sheet 1.

Twenty pins of 60 pin connector J404 interface the CAPNOSTAT® CO_2 sensor with the system electronics. Ferrite and L-C filters have been placed on selected lines to suppress radiated EMI and reduce susceptibility from external sources of interference.

Barometric Pressure Circuitry

Refer to 2754-03 schematic sheet 6.

IC28 is a piezoresistive differential pressure transducer with port P2 held as close to 0 psi (a perfect vacuum) as is possible. It measures the absolute pressure difference at port P1 relative to the vacuum at port P2. The transducer is calibrated for a full scale output of 0 to 15 psi, has internal temperature compensation and is designed to be driven by a constant voltage source. Instrumentation amplifier IC30 conditions this signal to correspond to the current barometric pressure, which is set by adjusting VR1. The nominal gain of this amplifier is 93.56, which corresponds to an ADC count of 3800 at 760 mmHg. The output signal from IC30 is low pass filtered by IC29A and appears as an input (ABPRESS) to the 12-bit ADC.

Sampling Pump

Refer to 2754-03 schematic sheet 2.

To enable the monitoring of non-intubated patients, a single tapered sampling port is provided on the sensor interface panel. Voltage regulator IC49 adjusts the pump motor speed to set the flow rate of air through the tubing system for 180ml/min. Resistor's R275 and R277 set the voltage to approximately 2.5V. VR2 is a potentiometer in parallel with R277, which can be installed if more accuracy is required for a flow rate adjustment. Pump motor current is sensed by measuring the voltage developed across resistor R278 using amplifier IC50 that provides a gain of 63. This provides an output of 8mA per 1/2 Volt{ $_{o} = (I_{pump}*R) / Gain$} into the 12-bit ADC, or approximately 2.5 uA per bit resolution {$Vref_{(ADC)} / (2^{12}*Gain)$}* {4mA/V}. A two-pole 31 Hz filter composed of IC29B provides high frequency attenuation. The VPUMP signal is digitally converted by IC6 and monitored by the processor.

Digital and Analog Control Lines

Refer to 2754-03 schematic sheet 2.

IC10 is enabled by theLATCH2_CS* line from the processor, the D8-D15 data lines then control the following signals:

SPO2CAL	Not used
SPO2SC1	Not used
SPO2LPON	Not used
INSIG	Not used
SIGND	Not used
BACKLIGHT	Used with LITE_CLK for display's backlight control
POWER_ON	Powers the monitor down (active low)
PUMP_CTRL	Controls sampling pump

Analog signals in the system are converted to digital values by IC6 then analyzed by the processor

CO2DATA	CO2 data channel
CO2REF	CO2 reference channel
CO2ISRC	Current through CO2 sensor's source
CO2CASE	CO2 sensor case temperature
CO2DET	CO2 sensor detector temperature
ABPRESS	Barometric pressure
SPO2FEDC	Not used

SPO2IRLED	Not used
SPO2IRLED	Not used
VPUMP	Monitors current through the sampling pump
VBATTADC	Battery voltage level

3.3 Power Supply and Battery Charger

Supply and Reference Voltage Generation

Refer to 2754-03 schematic sheet 8.

The monitor operates from either an isolated external DC power supply or from the internal battery. There are two options presently for the internal battery, a Nickel Metal Hydride battery pack (NiMH), or a Disposable AA Lithium cell pack. The NiMH battery pack operates from a nominal voltage of 7.2V down to 6.0V while the AA Lithium pack operates from 10.5V down to 6.0V. This battery voltage range is monitored in hardware by the 12-bit ADC for level and comparator IC37A in order to shut the unit down at approx. 6.0V. The NiMH battery can be charged either externally via a separate charger or internally when the DC input is connected and a NiMH battery is installed. The internal battery charging circuitry is located on the 2753-01 assembly and is described in a later section of this document. The Lithium battery pack has a schottkey diode in series with the positive battery terminal to prevent accidental charging of the Lithium cells.

The core of the power supply design for the system is a 500 KHz switching regulator, IC36, that utilizes a flyback transformer configuration to generate the analog DC supply voltages. The primary of the transformer is designed to accept 6.0 to 13 V DC input and provides secondary outputs of nominally +13.75VDC, and -13.75VDC which are regulated by R204 and R210 off of the +VA supply. These supplies (±VA) feed all of the analog circuitry in the monitor. All supplies are L-C filtered to minimize noise in the analog front end. An additional switching regulato (IC41) generates the 5VDC supply (VDD) which feeds all the logic circuitry in addition to a filtered version (CVDD) which supplies the logic level requirements of the CO_2 signal path (i.e. data converters e.t.c.). The 5V supply is L-C filtered to provide clean logic supplies for the analog sections of the CO_2 (CVDD) system. IC35 and IC40 are linear regulators which provide clean, well regulated supplies (±CVA) for the CAPNOSTAT® CO_2 sensor. IC38 and IC39 are designed as a tracking regulator pair to provide a 24VDC differential voltage for powering the CAPNOSTAT® CO_2 sensor source (+VSRC, -VSRC). Power for the CAPNOSTAT® CO_2 sensor heaters is supplied by VDCIN for maximum efficiency.

Refer to Table 6 for power supply breakdown.

Table 5: Power Supply and Reference Outputs

Signal	Supply	Description
VDCIN	+6.0 V to +13 VDC	Main DC input generated from external DC input or internal battery.
VBATT	+6.0 V to +10.2 VDC	Internal battery DC input, max level dependent on battery installed.
VBACKUP	+2.5 VDC or +5 VDC	Supply for SRAM and real time clock, either VDD or 2.5V to maintain SRAM data during power down.
VHTR	VDCIN	Supply for the CAPNOSTAT® CO_2 sensor case and detector heaters, supplied by battery or external DC input. When powered by battery heater power follows input power.
VDD	+5 VDC	Regulated digital logic supply .
CVDD	+5 VDC	Regulated and filtered logic supply for CO_2 analog front end.
+VA	+13.75 VDC (nominal)	Tightly regulated +13.75V DC supply.
+CVA	+12 VDC	Linearly regulated and filtered positive supply for the CAPNOSTAT® CO_2 sensor and CO_2 front ends.
+VSRC	+12 VDC	Linearly regulated and filtered positive supply for the CAPNOSTAT® CO_2 sensor source. Tracks -VSRC to provide a 24V +/- 2.5% differential voltage across the source.
-VSRC	-12 VDC	Linearly regulated and filtered negative supply for the CAPNOSTAT® CO_2 sensor source. Tracked by +VSRC to provide a 24V +/- 2.5% differential voltage across the source.
-VA	-13.75 VDC (nominal)	Loosely regulated off of the +13.75VDC feedback line.
- CVA	-12 VDC	Linearly regulated and filtered negative supply for the CAPNOSTAT® CO_2 sensor and CO_2 front ends.
CVREF	+2.5 VDC	Buffered reference for the A/D converter.
2CVREF	+5.0 VDC	Buffered reference used in the CAPNOSTAT® CO_2 sensor heater control circuitry.
-2CVREF	-5.0 VDC	Buffered reference used for the contrast control circuitry.
VREFO/2	+1.25 VDC	Buffered reference used for DC excitation for the barometric pressure sensor

Table 5: Power Supply and Reference Outputs

SPO2VLED	0 to 2.5 VDC	Not used
VDISP	-6.5 to -11.5 VDC	Negative bias supply for the LCD used to adjust the contrast level.

Refer to 2754-03 schematic sheet 6.

Stable reference voltages for the sensors and analog circuitry are derived from IC25, a precision 2.5V reference generator with low drift. Five (2CVREF) and 2.5 Volt (CVREF) references for the CO_2 circuits are generated by IC27, while a separate –5.0 Volt (-2CVREF) supply is generated directly from IC31A for –VA and -VD on the 20 bit ADC's for the saturation front end.

Refer to 2753-03 schematic

When the monitor is operated from the DC input power source the green AC ON indicator on the front panel is lit. If DC input power is lost or is not available, the monitor automaticall operates from its internal battery without interruption. The AC ON indicator is extinguished and a BATTERY LED on the front panel lights up, indicating the current voltage level of the battery. While on internal DC power, the current state of the battery is monitored by both software and hardware (IC37 2754-03 schematic sheet 8). Should the battery power level get critically low, the monitor software alerts the user. If the monitor is not placed on external DC input power within approximately five minutes, the software will shut the unit off. Should the software fail to turn the monitor off when the low battery alarm sounds, the hardware cutoff (IC37A) activates (+VBATT=6.0V), turning the unit off. The trend memory data stored in SRAM is retained by the presence of VBACKUP power which is generated by a 3 Volt on-board Lithium battery.

Battery Charger Circuitry

Refer to 2753-03 schematic sheet 1.

The internal NiMH battery (7.2V, 3Ahr) will charge when the monitor is connected to the external DC power supply (9220-10) or installed in the Base Station option (PN. 6998-00) with the external adapter connected to the Base Station.

Battery charging is controlled by IC1, a frequency modulated fast charge controller. IC1 monitors temperature, voltage, and time throughout the charging process to safely and effectively charge the internal battery. The charger is configured to terminate charging using the (delta temperature/delta time) method of charge termination. Charging is maintained at the C/4 (750mA) rate while current to the battery is controlled by Q1, Q2, Q3, and the "MOD" output of IC1. Q3 provides base drive for Q1 while Q2 serves to shut Q1 off very quickly on a cycle by cycle basis, allowing the large currents required for charging to pass through Q1 which is a surface mount SOT-23 package PNP transistor capable of 500mW's of power dissipation.

Charge current is monitored at the SNS input (IC1/9) and is set by R13 (I_{REG} = 0.2225V/2*R_{SNS}). Temperature is monitored using the battery's internal thermistor, in conjunction with R9, R10, and R12. R9, R10, and R12 set the deltaT/dt charge termination parameter to 1°C per minute. R7 and R8 set the maximum temperature for charge termination (a safety override) to 45°C.

Battery charging is initiated in one of two ways: either by applying 13.0 VDC to +VCHG, therefore providing VCC (BVDD) to IC1; or by inserting a rechargeable battery into the battery compartment. Resistors R2 and R4 form a divider which sets the battery voltage window. If a battery with a voltage below the lower threshold (V_{EDV}, end discharge voltage, V_{EDV} = 0.4*BVDD +/- 30mV or, 2.04V, +VBATT = 5.26V) is installed, the charger will remain in maintenance mode until the threshold is reached. Conversely, if the battery exceeds the upper

threshold for maximum cell voltage (V_{MCV}, maximum cell voltage, V_{MCV} = 0.8*BVDD +/- 30mV or, 4.08V, +VBATT = 10.5V), charging will terminate. After fast charge is terminated, either by deltaT/dt or by time-out, the charger switches over to a maintenance charge of C/64 to keep the battery topped off. BVDD (VCC for IC1 and D4, the AC on indicator) is regulated by D10, a 5.1V zener diode, while R3 keeps D10 operating in the knee region and C5 and C6 provide filtering.

Over-current protection is provided by F1, a 1A slo-blo replaceable fuse. Reverse leakage protection is provided by D5 and D6 which prevent the battery from trying to power BVDD and +VCHG in the battery operation state.

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Section 4 *Functional Tests*

The Functional Test verifies overall functional integrity of the monitor and sensor. If the Model 615 monitor does not pass these tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

4.1 Equipment Required

1. Single Patient Use Adult Airway Adapter PN: 6063-01
2. Single Patient Use Neonatal Airway Adapter PN: 6312-01
3. NiMH rechargeable battery pack PN:400043 or equivalent,
   (batteries (7) “AA” 1.5V PN: 400050 and case PN: 6862-01, if supplied)
4. External DC power supply PN: 9220-10 and hospital grade line cord PN: 600026
5. Single Patient Use Sampling Adapter PN: 8954-01
6. Sample line tubing and cannula

4.2 Procedure

Power up

1. Visually inspect the monitor and verify that there is no external damage.
2. Open hinged cover and install the NiMH rechargeable battery pack (fully charged) PN: 400043 into the unit.
3. Connect the external DC power supply PN: 9220-10 to an AC outlet using a hospital grade line cord, then plug the other end into the unit under test.
4. Verify the LED on the keypanel illuminates.
5. Power the unit up by pressing the POWER key on the keypanel. The monitor will display “Novametrix Medical Systems Inc. Model 615 Checking System” then the adapter mode that was last selected and the current setting for the alert limits (enabled or disabled). The keypanel LEDs will illuminate in sequence during the power up sequence.
6. Verify the monitor displays “CAPNO WARMING” then “CHECK ADAPTER” at the top of the display.

7. Press both ☼ and (ADAPTER) keys simultaneously to display the configuration settings. Before changing any parameter record the current settings so that the unit may be returned to its' original configuration. Use the PAGE (PAGE) and SELECT (SELECT) keys to set the following parameters (these are also the factory default settings):

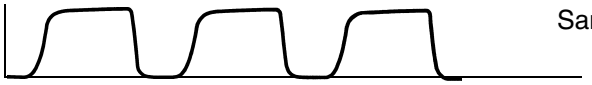
GAS COMPENSATION	ROOM AIR
CO2 WAVEFORM SCALE	MEDIUM
CO2 WAVEFORM SPEED	MEDIUM
NO RESP TIMER	20 sec.
CO2 UNITS	mmHg
ALERT VOLUME	HIGH
RS232 INTERFACE	NOVACOMM
WAVEFORM FILL	UNFILLED
$ETCO_2$ AVERAGING	10 SEC
ALERT LIMITS	DISABLED
RESP TREND SCALE	MEDIUM
AUTO POWER OFF	ENABLED

When all the parameters are set press the ADAPTER (ADAPTER) key to exit.

Capnography Tests

8. Press the ADAPTER (ADAPTER) and use the SELECT (SELECT) to select ADULT, then press EXIT (EXIT)
9. Connect a Single Pateint Use Adult Airway Adapter PN: 6063-01 to the CAPNOSTAT® CO_2 sensor. (Perform adapter zero only if requested by the monitor).
10. Press the PAGE (PAGE) to display the CO_2 Waveform Screen.

11. Breathe into the airway adapter at a normal breath rate for at least 30 seconds, verify both the readings and the waveform displayed on the unit are acceptable.



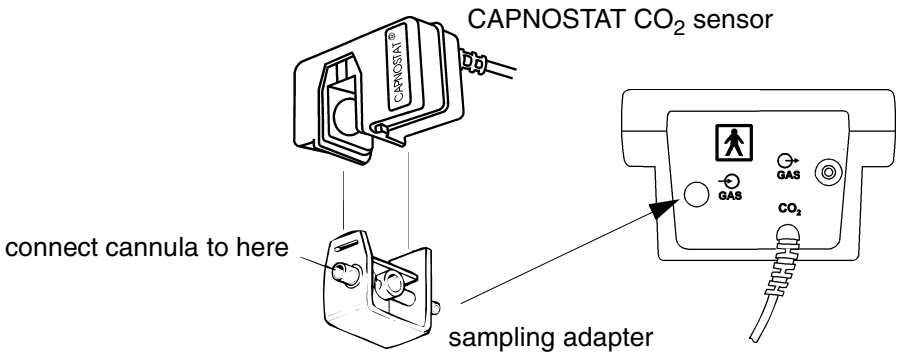
Sample Waveform*

*(Waveform appearance will vary depending upon breath rate and CO_2 waveform speed.)

12. Stop breathing into the adapter and verify an alert condition after approximately 20 seconds (alert LED flashing red and an audio alert). Press the ALERT key and verify the alert tone silences. Verify a 2 minute audio silence is initiated and the LED on this key is flashing red then yellow.
13. Press the PAGE key until the ETCO $_2$ Trend Screen is displayed, verify a trend waveform is present (waveform starts from right).
14. Press the ALERT key.
15. Change the airway adapter on the CAPNOSTAT® CO_2 sensor from the adult to the neonatal.
16. Verify that “CHECK ADAPTER” is displayed.
17. Press the ADAPTER key and use the SELECT key to select NEONATAL, press EXIT . Verify the unit is in the Neonatal Mode as indicated by the “NEO” on the screen. (Perform adapter zero only if requested by the monitor).

Sidestream Tests

18. Connect a Single Patient Use Sampling Adapter to the CAPNOSTAT CO_2 sensor.



19. Press the ADAPTER key then use the SELECT key to select SAMPLING, press EXIT . Verify the sampling pump turns on.
20. With all sources of CO_2 removed from the adapter and tubing, press and hold the ADAPTER key for 4 seconds, then use the ZERO key to zero the adapter.
21. When the zero is complete, remove the Single Patient Use Sampling Adapter and verify the pump turns off. Attach a Single Patient Use Adult Adapter.
22. Press the ADAPTER key and use the SELECT key to select ADULT, then press EXIT

Miscellaneous Tests

23. Press the Backlight key and verify that the back light turns off. Press the backlight key again and verify the back light turns on.
24. Press and hold the Backlight key and verify that the display contrast is adjustable from light to dark. Set the contrast of the display to a viewable level.
25. Remove the external DC power supply from the unit and verify that the AC ON LED is off and the Battery LED is illuminated (green).

26. Power the unit down then power it back up again. Ensure the monitor functions properly on battery operation.
27. Power the unit down and remove the rechargeable battery pack from the unit.
    NOTE: The following steps do not apply if the monitor does not have an “AA” battery pack.
28. Install (7) seven “AA” batteries into the battery case PN:6862-01 ensuring proper polarity.
29. Install the battery case into the unit, power up the unit and ensure it functions properly on battery power.
30. Turn the unit off by pressing the Power key. Remove the battery pack from the unit. Remove the “AA” batteries from the battery case.

Section 5 *Accuracy Tests*

The Accuracy Test verifies the performance accuracy of the Model 615. This test is typically performed in conjunction with (after) the Functional Tests described on page 23. If the monitor does not pass the accuracy test, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

This procedure assumes the technician performs each step as indicated—leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

5.1 Equipment Required

1. Single Patient Use Adult Airway Adapter, PN: 6063-01, Qty 3
2. NiMH rechargeable battery pack (fully charged), PN: 400043 or equivalent.
3. External power supply, PN: 9220-10 and hospital grade line cord PN: 600026
4. Model 1298 Gas Regulator, PN: 6081-00
5. Precision gas mixture, PN: 8364-10
6. Nova Princo Barometer or equivalent
7. Thermometer (measure ambient room temperature)

5.2 Procedure

1. Visually inspect the monitor and verify that there are no cosmetic defects.
2. Install a fully charged MiMH rechargeable battery pack (PN: 400043) into the unit under test.
3. Plug the external power supply (PN: 9220-10) into an AC outlet, then plug the other end into the unit's DC input.
4. Hold the d key down, press the POWER key to turn the monitor on and reset to factory defaults.
5. The monitor will display "Resseting Monitor to Factory Defaults", then “Novametrix Medical Systems Inc. Model 615 Checking System” then the adapter mode and the current setting for the alert limits (enabled or disabled). The keypanel LEDs will illuminate in sequence during the power up sequence.

6. Calculate the nominal CO_2 readings using the following equation:

$$N = \frac{(CO_2\%) \cdot (Pbaro)}{1-0.003 \cdot (33-T)}$$

Where:
Pbaro=barometric pressure in mmHg
T=temperature in degrees centigrade
N=the nominal corrected CO_2 value for the given CO_2%
CO_2%=percentage of CO_2 test gas used, e.g. 5% CO_2 test gas = .05

Example:

If T=23 and Pbaro=760
then
N=((CO_2%) · 760) / 1-0.003 · 10)
N=CO_2% · 783.505
N=39.2 (for CO_2%=.05 or 5% test gas)

For N<40; Low=N-2, High=N+2
For 40<N<70; Low=0.95 · N, High=1.05 · N
For N>70; Low=0.92 · N, High=1.08 · N

CO_2%=5 N=39.2 Low=37.2 High=41.2

7. Connect a Single Patient Use Adult Airway Adapter (PN: 6063-01) to the CAPNOSTAT® CO_2 sensor.
8. Press and hold the key until ">0< ?" appears on the screen. Ensure that the sensor and adapter are clear of any source of CO_2, including your breath. Press the ZERO y. Verify the adapter zeros then returns to the normal operating screen.

   NOTE: The CAPNOSTAT® CO_2 sensor mush reach operating temperature before zeroing. If the thermometer icon appears then the sensor has not reached proper temperature, wait one minute then attempt to zero again.
9. Connect the Model 1298 Gas Calibrator with 5% CO_2 gas and airway adapter stack to the airway adapter (see instructions with the calibrator).
10. Enter the Configuration menus on the unit by pressing both the ADAPTER key and key simultaneously.
11. Press the y until CAPNOSTAT SERIAL # and VERIFY ACCURACY appears.
12. Press the VERIFY ACCURACY key. Check that the value is 0.4 +0.5/-0.4 (no gas flowing through adapters).
13. Flow gas through the adapter for thirty seconds, record the reading. Verify the reading is between the Low and High limits for the CO_2% of 5 (5% CO_2 gas) a calculated in step 6.
14. Shut the gas flow off. Remove the Model 1298 Gas Calibrator from the airway adapter.
15. Press the EXIT y.
16. Enter the Configuration menus on the unit by pressing both the ADAPTER key and key simultaneously.

17. Press the -☼-y until CAPNOSTAT SERIAL # and VERIFY ACCURACY appears.
18. Press and hold the -☼→y for three seconds. Verify the following displayed parameters:

From Model 615 display		units (not displayed)
SRCI	180-300	mA
CTMP	45.00 ± 0.1	°C
DTMP	45.00 ± 0.1	°C
DCHN	3400 ± 200	A/D counts
RCHN	3400 ± 200	A/D counts

19. Pressing the EXIT y.
20. Remove the external power supply from the unit and verify that unit continues to function properly without interruption and that the Battery LED is illuminated (green).
21. Power the unit down by pressing the POWER key.
22. Remove the rechargeable battery pack from the unit.
23. The Accuracy Tests are complete.

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Section 6 *Electronic Tests*

The Electronic Tests verify the calibration and operation of the electronic circuits within the Model 615. These tests DO NOT need to be performed on a regular (preventative) basis. Perform these tests only if the monitor fails to operate as expected or fails the Accuracy Tests or the Functional Tests. The Electronic Tests should be performed only by qualified personnel. The Electronic Tests require access to the internal components of the monitor. Refer to page 44 for disassembly.

CAUTION

The Model 615 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

6.1 Equipment Required

1. External power supply, PN: 9220-10 and hospital grade line cord PN: 600026
2. Single Patient Use Sampling Adapter PN: 8954-01
3. Sample line tubing and cannula (to be modified) PN: 8957-01
4. Dehumidification tubing PN: 8908-01
5. Mass Flow Meter, Aalborg GFM17* or equivalent
   1/8" Y - fitting
   1/8" ID PVC tubing (1 1/2" length)
   3/32" ID PVC tubing (2 - 1" lengths)
6. Nova Princo Barometer* or equivalent
7. D.M.M., Fluke Model 8840A* or equivalent
8. Oscilloscope, Tektronix Model 2236* or equivalent
9. Leakage Tester*

   * Calibrated

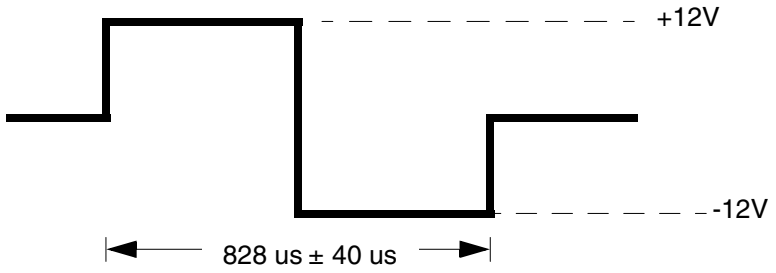
6.2 Test Procedure

1. Remove the battery (trends, date and time will be lost).
2. Disassemble unit to expose circuit boards.
3. Situate the boards so that no shorting can occur. Connect the external DC power supply.

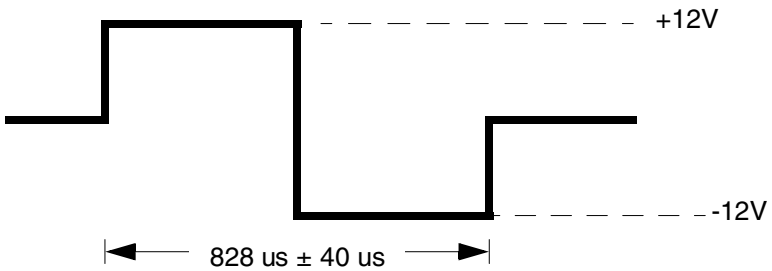
4. Press the POWER key to power up the main board. Verify the proper power up sequence is on the LCD display.
5. Measure the following voltages. Use TP 37 as ground reference.

Signal Name	Location	Side	Voltage	Tolerance
VDD	TP 43	Front	5.00 V	± 100 mV
+ VA	TP 31	Front	+ 13.75 V	± 500 mV
- VA	TP 40	Front	- 13.75 V	± 500 mV
+ CVA	IC 35 pin 2	Front	+ 12.00 V	± 500 mV
- CVA	IC 40 pin 3	Front	- 12.00 V	± 500 mV
+ VSRC	IC 38 pin 2	Front	+ 12.00 V	± 500 mV
- VSRC	IC 39 pin 3	Front	- 12.00 V	± 500 mV
VBATTADC	IC 37 pin 3	Front	+ 1.80 V	± 100 mV
VHTR	C148 Positive	Front	+ 8.00 V	± 1.00 V
CVREF	TP 24	Back	+ 2.50 V	± 25 mV
2CVREF	TP 23	Back	+ 5.00 V	± 50 mV
- 2CVREF	TP 26	Back	- 5.00 V	± 50 mV
VBACKUP	IC 8 pin 8	Front	+ 4.60 V	± 150 mV
LEDSRC	TP 45	Back	+ 11.50 V	± 1.00 V

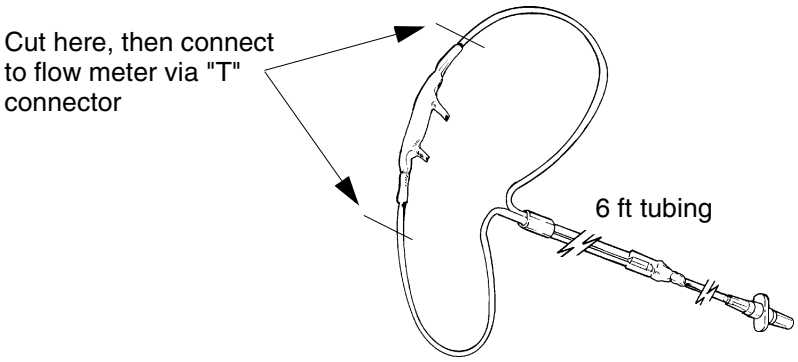
6. Monitor pin 4 of IC36 (or pin 5 of IC41) and insure that a 655 kHz sync frequency is present. Check that pulse amplitude is switching between 0 and 5VDC.
7. Monitor IC13-2 with an Oscilloscope. Verify a positive pulse 405 ± 10 us wide.
8. Monitor IC14-2 with an Oscilloscope. Verify a positive pulse 393 ± 10 us wide.
9. Monitor Q5 pins 5-8 with an oscilloscope. Verify the following waveform:



10. Monitor Q6 pins 5-8 with an oscilloscope. Verify the following waveform:

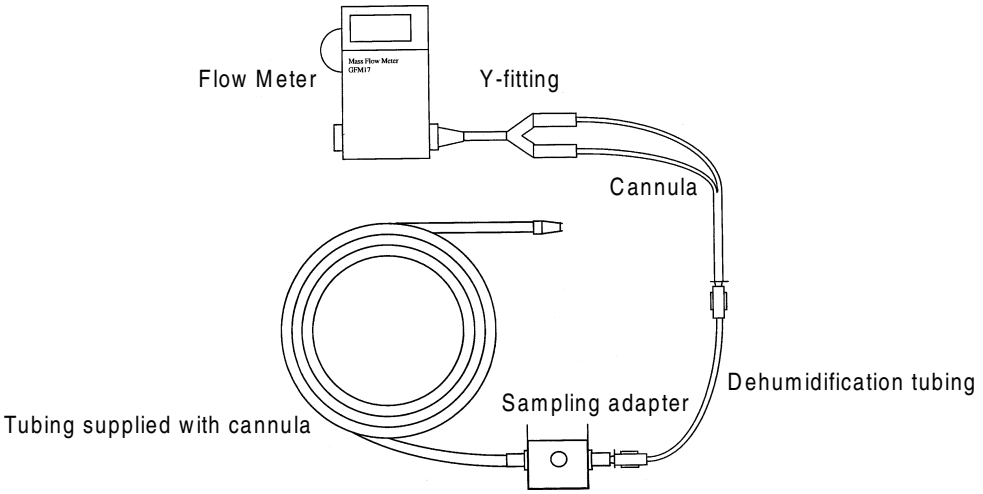


11. Enter the Configuration menus on the unit by pressing and holding the ADAPT key immediately followed by the key.
12. Press the key until CAPNOSTAT SERIAL # appears and VERIFY ACCURACY.
13. Press and hold the key.
14. Using a calibrated barometer, read the barometric pressure.
15. Adjust VR1 (on the 2754 bd.) until the PB equals the actual barometric pressure ± 2.
16. Cut the nasal cannula as shown below. Bond the 3/32" PVC tubing to each cut end, then connect to the Y fitting. Connect the 1/8" PVC tubing to the to the output of the Y fitting.



Bond the PVC tubing to the cannula using a 50/50 mix of THF and Cyclohexanone. Dip the cut cannula ends into the mix for one second, wipe off excess then connect to the PVC tubing, allow to set for a period of five minutes. Verify there are no occlusions.

17. Connect the cannula and dehumidification tubing to a sampling adapter as shown below.



18. Attach the dehumidification tubing to the monitor (the CAPNOSTAT CO_2 sensor should be connected to the adapter).
19. Measure the voltage at J402 pin 1. Verify 0.00V ± 50mV.
20. Press the Adapter key. Verify a Set Adapter Type menu is displayed.
21. Press the Select key until Sampling is selected.
22. Install a Single Patient Use Sampling Adapter and verify the sampling pump turns on and the Flow Meter shows a flow rate of 180 ± 25 (adjusted by VR2).
23. Measure the voltage at J402 pin 1. Verify 2.508V ± 75mV.
24. Press the Zero key to start a Zero calibration. Verify an Adapter Zero in Progress message is displayed with a timer counting down from 20. Verify the calibration completes with no error messages present.
25. Remove the Sampling Adapter and verify the pump turns off.
26. Press the Adapter key. Verify the Set Adapter Type menu is displayed.
27. Press the Select key until Adult is selected. Press the Exit key. Verify the sampling pump turns off and the main screen is displayed.
28. The test is complete.

6.3 Safety Testing

1. Using a leakage tester, and with the external DC power supply connected, measure the leakage current:
   - Normal
   - Normal reverse ground
   - Normal ungrounded

   Verify a leakage current <300 uA for 120VAC or <500 uA for 220VAC.

Section 7 Status Messages

Status messages indicate conditions that should be corrected or monitored; they may or may not be tied to an alert condition. These conditions can be a result of a hardware or sensor fault condition. Status messages are displayed on the screen in the same manner as alert messages. Following is a list of status and alert messages that may appear on the monitor.

7.1 System Messages

Message	Description
PRESSURE FAULTY	The barometric pressure sensor is returning a value which is out of range (<400 mmHg or > 800 mmHg). The monitor will default to 760 mmHg for calculation purposes. Refer servicing to qualified personnel.
EtCO2 AUTO LIMITS SET	This message is displayed when the monitor has successfully determined and set the auto alert limits for $ETCO_2$.
RESETTING TO FACTORY DEFAULTS	All setup and alert settings have just been reset to factory default values.
TRENDS ERASED	The trends stored in the monitor's memory have been erased.
CHECK TIME/DATE	Time and date may not be properly set. The time and date can be adjusted in the CONFIGURATION menu by pressing the ☼ Backlight key.
UNKNOWN ERROR	Remove the monitor from use and contact Novametrix service personnel.

7.2 Capnography Messages

Message	Description
CAPNO WARMING	Sensor is under temperature. Wait for the CAPNOSTAT® CO_2 sensor to reach operating temperature.

Message	Description
CHECK ADAPTER	Excessive moisture or secretions detected in the adapter: Change adapter. Adapter type has been changed (e.g. adult to neonatal): Zero the adapter. No adapter detected: Place an adapter on the CAPNOSTAT® CO_2 sensor.
RESP=0 m : ss	A breath has not been detected for the indicated time (XX seconds). This message appears when the time since the end of expiration of the last detected breath exceeds the NO RESP TIMER setting in the configuration menu.
INSP XX	An inspired CO_2 level of 3 mmHg (or 0.4% or kPa) was detected for 20 consecutive seconds.
ZRO: HOLD ADPT KEY	The current through the CAPNOSTAT® CO_2 sensor source emitter has changed or the system is detecting $EtCO_2$ values less than -3.0 mmHg.
CAPNO FAULTY	The following errors may be present: 1. The current through the source is too high or low. 2. The checksum for the CAPNOSTAT® calibration data is wrong. 3. The revision of the calibration data in the CAPNOSTAT® is not compatible with the software in the *TIDAL WAVE Sp* Monitor. Refer servicing to qualified personnel.
CAPNO HI TEMP	The temperature of the case or detector heater is over 50°C. Refer servicing to qualified personnel.
CAN NOT ZERO CO2	An error was detected which did not allow the system to zero the current adapter being used. Refer servicing to qualified personnel.
CO_2 OUT OF RANGE	The detected waveform value is beyond the measurement range of the monitor (0-100 mmHg, 0-13.2% or kPa).
	A changing level of CO_2 was detected during an adapter zero procedure. Wait 30 seconds and retry.
	The CAPNOSTAT® CO_2 sensor has not reached operating temperature while attempting to zero. Wait for the sensor to reach operating temperature.
ADAPTER ZERO IN PROGRESS, TIME REMAINING 0 : XX	An airway adapter zero is in progress. XX indicates the number of seconds remaining.
WARNING: CHANGING CO2 UNITS ERASES STORE TRENDS	Changing CO_2 units (mmHg, %, kPa) in the Configuration menu will cause this message to appear.

Section 8 *Maintenance*

8.1 General

This section presents recommended maintenance schedules for the Model 615 and information on general maintenance, such as battery and fuse replacement, disassembly and assembly instructions, and system software updates.

8.2 Maintenance Schedules

When the monitor powers up, a self-test is performed which checks the internal electronics of the monitor. If this self-test fails, remove the monitor from use and contact qualified service personnel.

The monitor should undergo routine inspection and safety checks on a quarterly basis or according to hospital protocol.

The electronic circuits within the Model 615 handheld capnograph do not require scheduled calibration or service. However, in order to maximize battery life, the monitor's internal battery should be tested monthly. Novametrix recommends the following maintenance schedules.[1]

- Cleaning and Sterilization:
  Perform as required. See "Cleaning and Sterilization" on page 38.
- Battery and AC Operation:
  Contains information on rechargeable batteries. See "Battery Maintenance" on page 39.
- Functional Tests:
  The test verifies overall functional integrity of the monitor and sensor. See "Functional Tests" on page 23.
- Accuracy Tests:
  The test verifies the calibration accuracy of the monitor using specified test apparatus. See "Accuracy Tests" on page 27.
- Electronic Tests:
  These tests contain information on testing the electronic circuits within the Model 615 and should only be performed if the monitor fails to pass the Functional Tests. Only qualified service personnel should attempt to perform the Electronic Tests. See "Electronic Tests" on page 31.

1. At the customer's request, Novametrix will provide repair and calibration services under terms of a Service Contract. Contact the Novametrix Service Department for contract details.

8.3 Cleaning and Sterilization

Follow the cleaning and sterilization instructions listed below to clean and/or sterilize the monitor and its accessories.

Monitor, BaseStation and External Power Supply

- Turn the monitor off, and unplug the BaseStation and the external power supply from the AC power source before cleaning.
- The monitor, BaseStation and external power supply can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutheralhyde, or 10% bleach solution. Wipe down with a water-dampened clean cloth to rinse. Dry before use.
- Do not immerse the monitor, BaseStation or external power supply.
- Do not attempt to sterilize the monitor, BaseStation or external power supply.

CAPNOSTAT® CO_2 Sensor

- Clean the sensor surface with a damp cloth.
- Make certain that the sensor windows are clean and dry.
- Do not immerse the CAPNOSTAT® CO_2 sensor.
- Do not attempt to sterilize the CAPNOSTAT® CO_2 sensor.

Single Patient Use Airway Adapters

- Treat all single patient use airway adapters in accordance with hospital protocol for single-patient use items.

External Sampling System Components

- The Nasal Sampling Cannulas and adapters are for single-patient use.

Internal Sampling System Components

Acceptable fluids for cleaning and sterilizing the internal pneumatic parts of the Sampling System include isopropyl alcohol, Cidex[2] or equivalent, or a 5.25% water solution by weight of sodium hypochlorite (bleach).

CAUTION

Do not attempt to pump cleaning/sterilizing liquid with the sampling pump. This may cause accelerated wear on the pump bearings. Always flush liquids with a syringe as described in the following instructions.

To clean and disinfect the pumping system:

1. Turn the monitor off and disconnect the external power supply (if connected).
2. Remove both the sampling inlet tubing set and the sampling exhaust tubing (if any).

2. Cidex is a trademark of Arbook, Inc.

3. Attach an exhaust port line (1/8 inch or 3/16 inch I.D. tubing) from the Sampling Exhaust GAS port to a suitable container located below the bottom level of the monitor.
4. Use a 60 cc catheter tip syringe. Fit it to the Sampling Inlet GAS connector. Flush the sterilizing solution slowly through the pumping system. Push the entire 60 cc of solution through the Sampling Inlet GAS. Repeat this process two more times to use a total of 180 cc of solution.
5. Remove the syringe and leave the cleaning/sterilizing fluid within the sampling pump system for 30 minutes to disinfect the system. Follow sterilant manufacturer's instructions for disinfection.
6. After 30 minutes, fill the syringe with distilled water and flush the system three times. Allow the cleaning/disinfection solution and distilled water to drain through the Sampling Exhaust GAS output.
7. Push several syringes of air slowly through the system to ensure that most of the liquid has been drained.
8. Follow this with at least three more syringes of distilled water, followed by at least two more syringes of air to make sure that most of the distilled water has been drained.
9. Remove the syringe from the unit. Do not connect the sampling inlet tubing. Connect the external power supply and turn the monitor on. Allow the sampling pump to operate for several minutes. This will help to remove any trapped water.
10. Connect a sampling tubing set to the Sampling Inlet GAS
11. Block the open end of the tubing with your finger. Alternate blocking and unblocking the tubing end at least ten times. Use a quick, brisk motion when blocking and unblocking the tubing. Keep the tubing blocked and unblocked for several seconds at a time.
12. Repeat the same blocking and unblocking action with your finger on the sampling exhaust GAS port.
13. Allow the sampling system to run for at least 30 minutes without the sampling assembly tubing and the sampling exhaust tubing connected. This will speed dry the system pneumatics.
14. Once these cleaning and disinfection instructions have been completed, normal sampling system operation can be resumed.

8.4 Battery Maintenance

New batteries, or batteries stored for extended periods of time (3 months or more) may need to be fully charged and discharged up to five (5) times before performing at full capacity. New batteries or batteries that have not been used for 30 days, should be charged for 24 hours prior to use.

AC/Battery Operation

The monitor can operate for up to 4 hours while powered from a fully charged internal battery. The battery is charging when the monitor is powered through its DC input and the key panel icon is green. The battery will charge even if the monitor is off. Power to the DC input is supplied

by the external power supply (Cat. No. 9220-10) with or without the optional BaseStation (Cat. No. 6998-00).

Rechargeable and disposable battery capacity is shown in the table titled, "Battery Life and Recharge Times" on page 44. Times may be reduced in colder temperatures or with the sampling adapter; operation with the backlight off may slightly increase these times.

Battery Status and Alerts

When the monitor is operating on battery power, and the battery is sufficiently charged, the battery icon LED on the keypanel will be green. The battery level is reflected on the battery icon by different colors (for example, battery fully charged: green, battery low: flashing yellow).

The LED on the keypanel flashes red when the monitor is powered by its internal battery and approximately 5 minutes remain. The monitor will sound an audible alert, then when the battery is depleted, turn itself off. This alert can only be silenced by connecting the external supply or turning the monitor off. The NiMH battery pack should be replaced, or th Model 615 BaseStation (Cat. No. 6998-00) or external power supply (Cat. No. 9220-10) should be connected to recharge the battery (rechargeable batteries only) and power the monitor. See "Battery Life and Recharge Times" on page 44.

NOTE

When the battery is low (red blinking battery LED on keypanel) the monitor has shut down CO_2 functions. Connect to AC power as soon as possible.

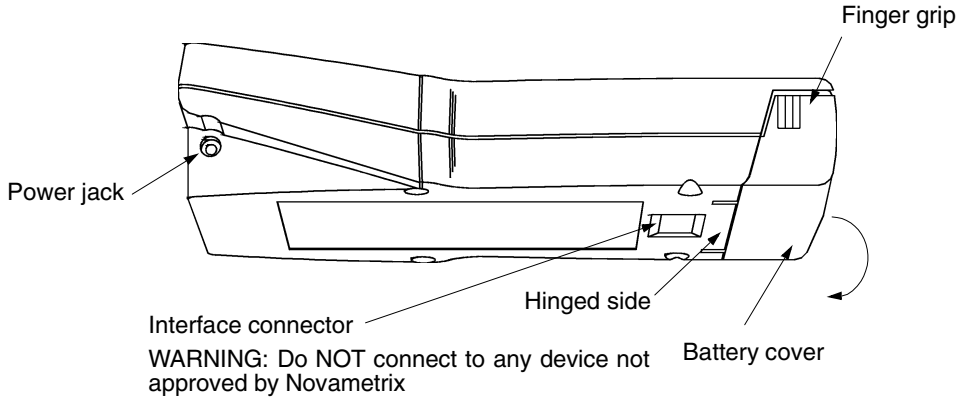
NOTE

The battery life indicator may not reflect the true battery status upon power-up for approximately 30 seconds.

The battery life indicator is inactive when the monitor is powered by the BaseStation or the external power supply.

Removing and Installing the Battery

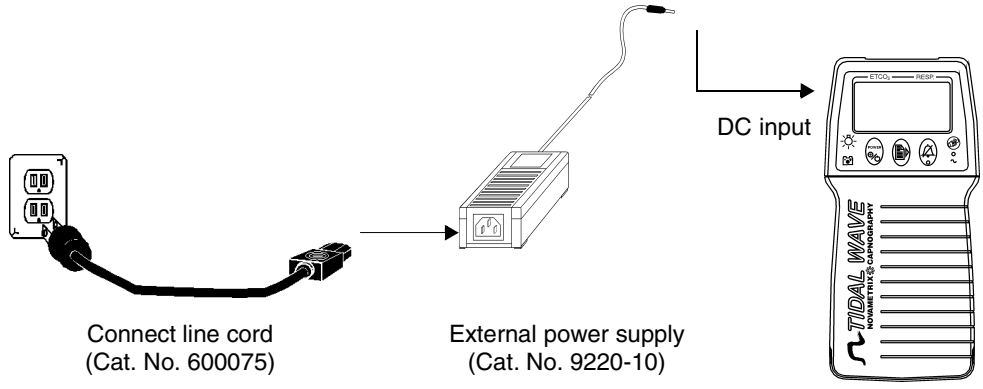
Grasp the finger grips on each end of the battery cover. Squeeze together and pull so that the cover opens to reveal the internal battery (the cover is hinged on the bottom of the case). Remove the battery from the monitor.



The battery is keyed so that it can be installed in only one way (see illustration inside battery compartment). The contacts should go in first and be located toward the top left of the monitor when inserting. Make certain the battery cover is properly closed before operating the monitor.

Charge using External Power Supply

Plug the external power supply directly into the DC power jack on the side of the monitor, and connect a hospital-grade line cord to an AC source. The AC icon ∿ will illuminate green and the battery will charge in approximately 5.5 hours. If the monitor has been stored with the battery installed for thirty (30) days or more, charge the battery for 24 hours prior to use.



CAUTION

Use only Novametrix supplied devices when connecting to the power input jacks on the Model 615 or on the BaseStation.

Do not attempt to use the adapter for the external battery charger for this function.

NOTE

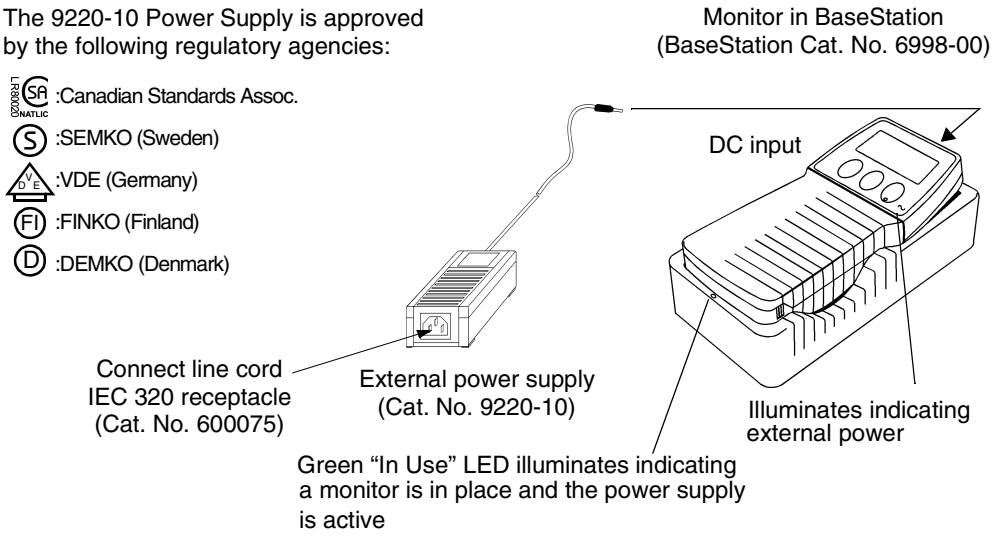
When powered by the external power supply, the Model 615 will not overcharge a rechargeable battery.

The external power supply has a universal power input. The IEC 320 input receptacle for line cord connection allows compatibility with every country's voltage and frequency requirements.

Charge using optional BaseStation

Power for the BaseStation is supplied by an external power supply (Cat. No. 9220-10) or the internal battery. When the power supply is properly connected to the BaseStation and a monitor is placed within the station the green, "In Use" LED will illuminate. The ∿ icon on the monitor will also illuminate indicating that external power is connected.

Connect the external power supply jack to the monitor and connect a hospital-grade line cord from the external power supply to an AC source.



CAUTION

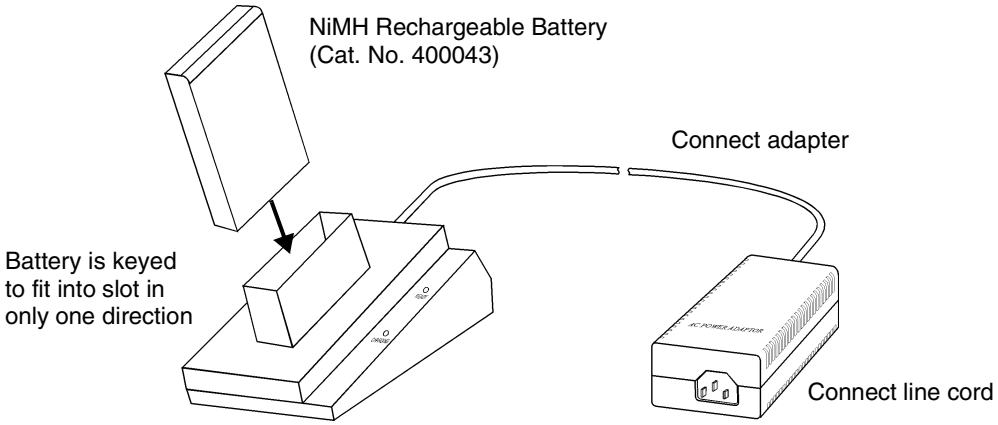
Although other connectors may physically fit, do not attempt to connect any device other than power supplies approved by Novametrix for use with this device. Doing so may damage the Model 615 and will void the warranty.

Never sterilize or immerse the monitor, sensor or accessories in liquids.

Charging with External Charger

In a non-patient area, connect the adapter to an AC source, then plug the adapter jack into the charger. Remove the battery from the Model 615 and insert it into the external charger. The battery will be fully charged in approximately 4.5 hours. The external charger is for use with the

NiMH rechargeable battery pack (Cat. No. 400043) only. Refer to the instructions supplied with the charger for additional information.



WARNING

The external battery charger should NOT be used to recharge the battery near or in close proximity to patients and/or other medical equipment in operation. It is intended for use in service areas only (i.e. nurses station, biomed lab, etc.).

NOTE

With a new battery, or a battery that has not been used for 30 days or more, charge the battery for 24 hours prior to use.

When powered by the external power supply or the BaseStation, the Model 615 will not overcharge a rechargeable battery.

The monitor may not operate on battery power if the battery is not sufficiently charged.

Dispose of batteries in accordance with local laws.

AA Lithium Batteries

To power Model 615 from AA lithium batteries, insert seven disposable batteries (Energizer L91 or equivalent) into the optional Battery Case (Cat. No. 6862-00) following the polarity markings on the Battery Case.

WARNING

Batteries can explode, leak or catch on fire if heated or exposed to fire or high temperatures.

Do not mix battery types (e.g. disposable and rechargeable AA batteries).

Battery Life and Recharge Times

Battery life:

Configuration	*Power source - Approximate Monitoring Times*	
	Rechargeable NiMH	*AA lithium batteries*
CO_2 only (sampling off)	*4.5 hours*	*4.0 hours*
CO_2 with sampling	*4.0 hours*	*3.5 hours*

Recharge times:

Recharge method	*Recharge times*
External charger w/adapter	*4.5 hours*
External power supply or External power supply/BaseStation (in monitor using wall adapter charger)	*5.5 hours - following recent use of more than approximately 4 hours. With a new battery, or a battery that has not been in use for 30 days or more, charge the battery for 24 hours prior to use.*

8.5 Assembly Exchanges

The disassembly instructions below are intended as a guide to enable component exchanges if necessary. There are no user serviceable parts inside. Disassembly should be performed by qualified service personnel only.

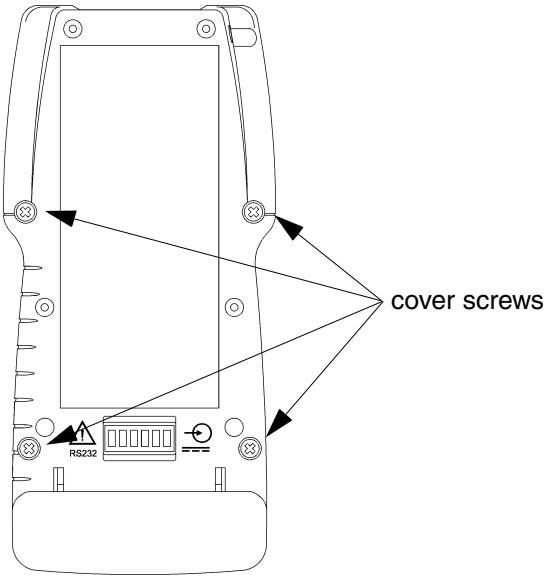
CAUTION

The Model 615 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

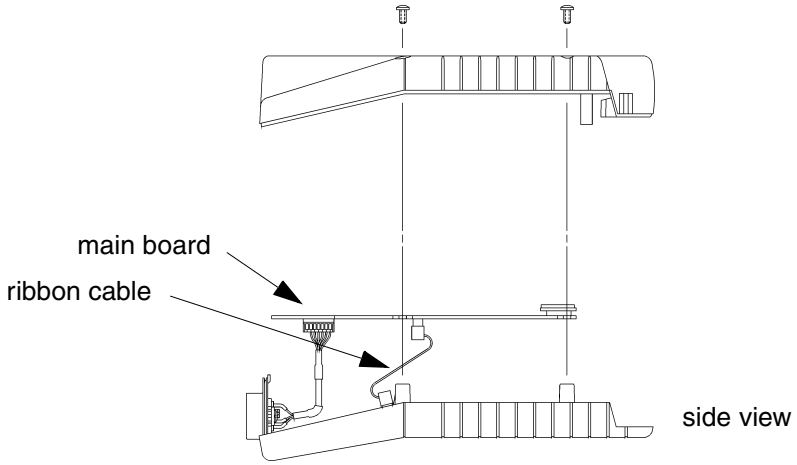
Disassembling the Monitor

1. Ensure that the monitor is OFF. Disconnect the A/C adapter, remove the battery pack.

2. Turn the monitor upside down and remove the four cover screws from the bottom cover.



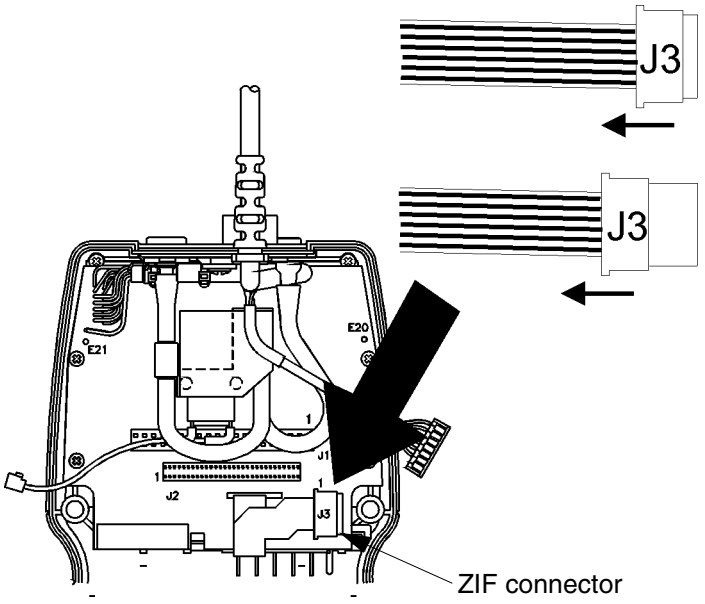
3. Carefully lift the rear cover from the monitor. The separate assemblies of the monitor can now be removed.
4. Lift the Main Board and disconnect ribbon cable from the Sensor Assembly Board by grasping the connector (not the cable) and gently rocking from side to side to loosen. Be careful not to bend any pins when pulling the connector off of the header strips.



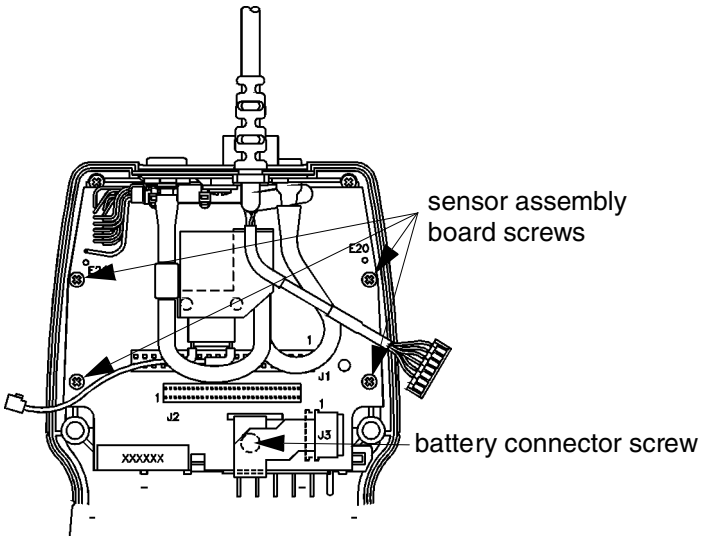
Unplug the pump connector from the main board.

5. Remove the Main Board.
6. The Sensor Assembly Board, Display Board, and battery connector can now be accessed.

7. To disconnect ribbon cable J3, grasp the edge of the ZIF (zero insertion force) connector with one forefinger on either side. Pull gentl *sideways* to release the mechanism. Slide the ribbon cable out.

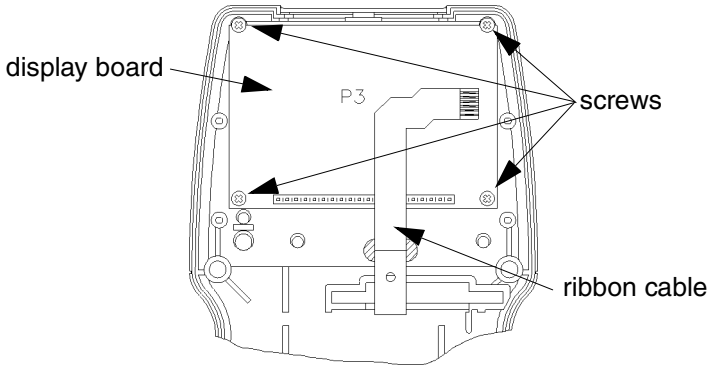


8. Remove four screws from the Sensor Assembly Board, then the screw near the battery connector.



9. Remove the sensor assembly board by gently prying upward, rocking gently to release the header strip J1 which connects through the Sensor Assembly Board from the Display Board below.

10. Remove 4 screws holding the Display Board in place. Do not bend the tabs on the board, the LCD display can not be removed from the board. Be sure not to lose the plastic bezel located in between the LCD display and the display window.



Reassembling the monitor

1. Check the inside of the display window and the LCD display for dirt/finger prints, clean if necessary. Replace the plastic bezel around the display window. Set the Display Board in place and secure with 4 screws.
2. Slide the ribbon cable through the sensor assembly board, align the Sensor Assembly board's J2 connector to the header strip on the display board. Check that the battery connector is aligned to the cover's receptacle. Just before pressing the Sensor Assembly Board into place, use a small screwdriver to set the ground strap from the keypanel into place.
3. Secure the Sensor Assembly Board with 4 screws. Then secure the ground strap with a screw
4. Slide ribbon cable J3 into the ZIF locking connector, pushing gently to be sure that the cable is as far into the locking mechanism as possible. Push the connector closed to lock in the ribbon cable. Pull lightly on the ribbon cable to ensure that it is secure.
5. Replace the three connections from the Main Board to the Sensor Assembly Board and align the main board with the standoffs.
6. Ensure the battery gasket is set in place, refer to the assembly print 6800-01 (page 3) for placement. Place the back cover on the monitor. Secure with 4 screws.
7. Opened hinged cover and replace the rechargeable battery or battery pack. Battery is keyed to fit in only one direction. When the monitor is powered it will default to the factory default settings.

8.6 Serial Communications/Power Interface Connector

Located on the enclosure rear is a six pin modular contact which provides an RS232 interface as well as a power input for unit operation and battery charging when connected to Novametrix accessories. This connector meets the patient safety requirements of the following agencies: IEC 601-1, UL544, and TUV.

8.7 Software Update Instructions

The following procedure is for updating the monitor's software from a supplied Model 615 Software Update Kit using an IBM-compatible computer and the Base Station (Cat. No. 6998-00). Refer to any instructions that may accompany the software update diskettes for changes in the procedure or other pertinent information.

Equipment Required

1. IBM compatible computer with an unused serial port (COM1 or COM2)
2. Base Station (Cat. No. 6998-00)
3. Serial Communication Cable (PN: 211923)
4. Update diskette PN: 9475-07-XX (XX = new firmware version)
5. Reply card

Setup

Connect the serial cable to the Base Station. Connect the other end of the cable to the computer's COM[3] (serial) port. The update software allows use of either COM1 or COM2. When connecting the cable be sure to record which COM port is used, the program will prompt the user for this information before updating the software.

Procedure

Turn the Model 615 off, then place it into the base station. Remove the AC adapter/charger connector from the base station if installed. NOTE: All power to the Model 615 must be removed otherwise the update will not operate properly.

Insert the update diskette into the computer's floppy drive (typically drive A).

From DOS: Type A: ↵ (where A is the drive letter where the update diskette is loaded). At the "A:" prompt type **UPDATE** then press ↵ .

From Windows 3.x: Boot to DOS and follow the DOS instruction above.

From Windows 9X/2000/NT: Select Start, Run, then type A:update ↵ (where A is the drive letter where the update diskette is loaded)

Follow the install program screen instructions. Verify that the firmware version shown on the computer screen is correct, then press any key to continue.

3. The location and availability of the COM ports (COM1, COM2) will vary from computer to computer. Refer to the computer's documentation for more information. The update software can only communicate with the Model 615 through either COM1 or COM2.

When the following prompt appears:

```
Select the PC's COM port the instrument is connected to
from the following choices:
     1-COM1
     2-COM2
     any other key - exit
```

Press the 1 key if the serial communications cable is connected to COM 1.
Press the 2 key if the serial communications cable is connected to COM2.
If you are not sure of the process, press any other key and call service or Novametrix Service Department at 1-800-243-3444, in Connecticut call collect (203) 265-7701.

Turn the Model 615 on (connect the AC adapter/charger to the base station if the battery is not fully charged). It is important that the Model 615 is powered off when the update program is started, and is turned on after the program starts to access the monitor.

When the download starts the Model 615 screen will blank and the following message wil appear on the computer screen.

```
Validating File
```

then,

```
UPDATING FIRMWARE, DO NOT INTERRUPT. PERCENT DONE: xx%
```

The "xx" will count up from 0% through 100% as the update is completed.

The procedure is complete when the computer displays:

```
***PROGRAM COMPLETE***

F1-exit          Esc-back
```

Press F1 to exit the update program.

Check that the Model 615 restarts and returns to normal operation, if not then perform the update procedure again or call Novametrix Service Department at 1-800-243-3444, in Connecticut call collect (203) 265-7701.

Record the serial number from the Model 615 on the reply card (supplied with software update disk). Fill in the remaining information and return the postage paid card to Novametrix.

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Warranty

Equipment manufactured or distributed by Novametrix Medical Systems Inc., is fully guaranteed, covering materials and workmanship, for a period of one year from the date of shipment, except for certain disposable products and products with stated guarantees other than one year. Novametrix reserves the right to perform guarantee service(s) at its factory, at an authorized repair station, or at the customer's installation.

Novametrix' obligations under this guarantee are limited to repairs, or at Novametrix' option, replacement of any defective parts of our equipment, except fuses, batteries, and calibration gasses, without charge, if said defects occur during normal service.

Claims for damages during shipment must be filed promptly with the transportation company. All correspondence concerning the equipment must specify both the model name and number, and the serial number as it appears on the equipment.

Improper use, mishandling, tampering with, or operation of the equipment without following specific operating instructions will void this guarantee and release Novametrix from any further guarantee obligations.

Service Department
For factory repair service, call toll free
1-800-243-3444
In Connecticut, call Collect (203) 265-7701
Facsimile (203) 284-0753
World Wide Web: http://www.novametrix.com
Internet: techline@novametrix.com

Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

Service Policy

Novametrix Medical Systems Inc. provides 24-hour a day access to technical support through its Technical Support Department in Wallingford, Connecticut, and company Service Representatives located throughout the United States. (Outside the U.S., primary technica support is handled through our qualified international sales and service distributors.)

Novametrix will provide Warranty Service support within 48 hours of receiving a request for assistance. Contact the Technical Support Department by telephone toll free at 800-243-3444, or 203-265-7701; by facsimile at 203-284-0753; or, by e-mail at techline@novametrix.com. After hours telephone support requests (before 8:00 AM and after 5:00 PM Eastern Time) will be responded to promptly by the Technical Support on-call staff. After hours facsimile and e-mail requests will be answered the next business day. It is suggested that any person calling in for technical support have the equipment available for product identification and preliminary troubleshooting.

Novametrix reserves the right to repair or replace any product found to be defective during the warranty period. Repair may be provided in the form of replacement exchange parts or accessories, on-site technical repair assistance or complete system exchanges. Repairs provided due to product abuse or misuse will be considered “non-warranty” and invoiced at the prevailing service rate. Replaced or exchanged materials are expected to be returned to Novametrix within 10 days in order to avoid (additional) charges. Return materials should be cleaned as necessary and sent directly to Novametrix using the return paperwork and shipping label(s) provided (Transferring return materials to a local sales or dealer representatives does not absolve you of your return responsibility.).

Novametrix manufactures equipment that is generally field serviceable. When repair parts are provided, the recipient can call Technical Support for parts replacement assistance and repair assurance. In the event a replacement part requires increased technical capability, Technical Support may request Biomedical assistance, provide on-site technical support or complete replacement equipment. If the customer requires the return of their original product, the exchange material will be considered “loaner material” and exchanged again after the customer equipment is repaired.

Novametrix promotes customer participation in warranty repairs, should they become necessary. A longer useful product life, and quicker, more cost-effective maintenance and repair cycles—both during and after the warranty period, are benefits of a smooth transition into self-maintenance. The Technical Support Department can provide technical product support at a level appropriate to your protocol and budget requirements.

Please contact Technical Support for information on these additional programs and services:

- Focus Series Technical Training Seminars
- Test Equipment and Test Kits
- Service Contract / Parts Insurance Plans
- On-Site Technical Support
- “Demand Services” including:
  - Flat rate parts exchange
  - Flat rate return for repair
  - Time and material,
  - Full warranty, discounted replacement sensors.

Section 9 *Specifications*

9.1 Specifications

General

Specifications for the Novametrix Model 615, are listed for informational purposes only, and are subject to change without notice.

Capnograph

- Principle of Operation: Non-Dispersive Infrared (NDIR) absorption, dual wavelength ratiometric-single beam optics
- Sensor Type: “Mainstream” (no gas sample drawn from breathing circuit)
- Initialization Time: Capnogram in 15 seconds, full specifications in 60 seconds.
- Response Time: 60 ms
- Gas Compensation - Room Air, O_2 > 60%, N_20 > 60%: Operator selectable in configuration screen.
- Barometric Pressure Compensation: Automatic (range 400-800 mmHg)
- CAPNOSTAT® CO_2 Sensor and Airway Adapter:
  Weight: Less than 18 g without cable
  Sensor Size: 1.30" x 1.67" x .85" (3.30 x 4.24 x 2.16 cm), 6 foot cable (2.44 m)
  Construction: Durable high performance plastic, ultra-flexible cable
  Shock Resistant: Sensor will withstand a 6 foot drop to a tile floor
- Airway Adapter: Single Patient Use, less than 5 cc deadspace, meets ANSI Z-79

$EtCO_2$ Section (Mainstream)

- Range 0-150 mmHg, CO_2 partial pressure
- Accuracy[1]: 0-40 mmHg ±2 mmHg, 41-70 mmHg 5% of reading, 70-150 mmHg ±8% of reading.
- Warm-up Time: Operational in 15 seconds, 1 minute to full specifications
- Step Response Time: 60 ms, adult; less than 50 ms, neonate
- Averaging Time: 1 breath, 10 seconds (default), 20 seconds, instantaneous
- Display Resolution: 0-25, 0-50, and 0-150 mmHg in 31 pixels
- Alerts: The Model 615 has user selectable alert limits for $EtCO_2$.

Respiratory Rate (Mainstream)

- Range 0-150 breaths/min.
- Accuracy: ±1 breaths/min.
- Alerts: The Model 615 will have user selectable alert limits for Respiratory Rate.
- Averaging Time: 8 seconds

1. Allows for halogenated anesthetic agents which may be present at normal clinical levels. The presence of desfluane in the exhaled breath beyond normal levels (5-6%) may positively bias Carbon Dioxide values by up to an additional 2-3 mmHg.

$EtCO_2$ Section (Sidestream)

- Range 0-150 mmHg, CO_2 partial pressure
- Accuracy: 0-40 mmHg ±2 mmHg, 41-70 mmHg 5% of reading, 70-150 mmHg ±8% of reading.
- Warm-up Time: Operational in 15 seconds, 1 minute to full specifications
- Step Response Time: less than 200 ms; Sampling Rate - 180 cc/min.
- Averaging Time: 1 breath, 10 seconds (default), 20 seconds, instantaneous
- Display Resolution: 0-25, 0-50, and 0-150 mmHg in 31 pixels
- Alerts: The Model 615 will have user selectable alert limits for $EtCO_2$.

Respiratory Rate (Sidestream)

- Range 0-70 breaths/min
- Accuracy: ±1 breaths/min.
- Alerts: The Model 615 will have user selectable alert limits for Respiratory Rate.
- Averaging Time: 8 seconds

9.2 Monitor Specifications

- Classification (IEC601-1): Class II/internal power source, type BF, enclosure protection rating of IPX1[2]. Operating Environment: 50 to 104° F (10 to 40° C), 0-90% relative humidity (non-condensing)
- Transport/Storage:
  short term: 14° to 122° F (-10° to 50° C) with NiMH battery
  long term: 14° to 95° F (-10° to 35° C) with NiMH battery
  storage: 14° to 131° F (-10° to 55° C) without NiMH battery
- Size: 7.9” x 3.25” x 1.5”
- Weight: 24 ounces
- Power: 100-250 VAC, .38A, 50-60 Hz
- Battery: Rechargeable NiMH battery pack (Cat. No. 400043) or equivalent; AA lithium batteries - Energizer L91 or equivalent.
- Battery Life: Approximately 4.5 hours of continuous use with fully charged NiMH rechargeable battery pack. Approximately 4.0 hours with sample pump in operation.
- Display: LED backlit 2.5” x 1.25” LCD, adjustable contrast
- LED indicators for: Low battery, adapter type, audio/alert status (indicates audio off, 2 minute silence, active alert), and external power.
- Electromagnetic Emissions: Conforms to EMC Directive 89/336/EEC, CISPR Class A. Tested to EN55011 (1991) and CISPR11 (1990).
- Electromagnetic Immunity: Conforms to EMC Directive 89/336/EEC, EN50082-1 (1992). Tested to IEC801-3 (1984) Radiated Immunity. Conforms to Medical Device Directive 93/42/EEC and EN60601-1-2 (1993). Tested to IEC801-2 (1991) ESD, IEC801-4 (1988) EFT, and IEC1000-4-5 (1995) Surge Immunity.

2. External power supply excluded.

Additional Features

- Alert Limits: Automatic or menu selected high and low limits for $ETCO_2$ and Respiratory Rate. NO RESPIRATION alert selectable between 20, 40 and 60 seconds. Visible and audible alerts are immediate.
- 2-Minute Silence: When key is pressed, audible alerts are deactivated for two minutes. Indicated by yellow 2 minute LED and flashing bell icon
- Audio Off: Press and hold key for 3 seconds to deactivate audible alerts. Indicated by flashing yellow Audio Off LED and flashing bell icon.
- Trend Memory: 24 hour trend memory capacity, battery backed. On-screen 30 minute trends for $ETCO_2$ and Respiration Rate. Other parameters are stored internally and can be downloaded to a PC.
- Digital Data Output: Serial (RS232), connect only to Novametrix approved devices.
- Sampling System: Standard. Allows gas sampling of non-intubated patients
- Internal Battery-backed Real Time Clock

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Section 10 *Accessories*

Catalog No.	Description
9425-00	*TIDAL WAVE* **Handheld Mainstream Capnograph and Sidestream Sampling (Model 615)** includes Single Patient Use Adult Airway Adapter (6063-01), Carrying Case (315127), and Single Patient Use Sampling Adapter with Adult Nasal CO_2 Sampling Cannula (8955 01).

CO_2 AIRWAY ADAPTERS and ACCESSORIES

For monitoring CO_2 with the CAPNOSTAT® CO_2 sensor.

6063-00	**Pediatric/Adult Single Patient Use Airway Adapters** (10 per box
6063-25	**Pediatric/Adult Single Patient Use Airway Adapters** (25 per box
6421-00	**Pediatric/Adult Single Patient Use Airway Adapters with mouthpiece** (10 per box)
6421-25	**Pediatric/Adult Single Patient Use Airway Adapters with mouthpiece** (25 per box)
6312-00	**Neonatal/Pediatric Single Patient Use Airway Adapters** (10 per box)
6312-25	**Neonatal/Pediatric Single Patient Use Airway Adapters** (25 per box)

SAMPLING ADAPTERS and ACCESSORIES

8954-00	**Single Patient Use Sampling Adapters** (10 per box)
8954-25	**Single Patient Use Sampling Adapters** (25 per box)
8955-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Adult** (10 per box)
8955-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Adult** (25 per box)
8956-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Pediatric** (10 per box)
8956-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling Cannula—Pediatric** (25 per box)
8957-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Adult** (10 per box
8957-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Adult** (25 per box
8958-00	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Pediatric** (10/box)
8958-25	**Single Patient Use Adapter w/ Nasal CO_2 Sampling and O_2 Delivery Cannula—Pediatric** (25/box)
8908-00	**Nafion® Dehumidification Tubing** (10 per box)

POWER SUPPLY OPTIONS

6998-00	**BaseStation** (External Power Supply and/or computer cable not included
9220-10	**External DC Power Supply** (power cord not included
6862-00	**AA Lithium Battery Pack** (requires 7 batteries)
400050	**AA Lithium Battery** (7 required)
400043	**NiMH Rechargeable Battery**
400049	**Battery Charger**, w/ AC Adapter, Universal Input Voltage, for type DR30 NiMH battery. Power cord included

MISCELLANEOUS

140084	**Pole/shelf mount kit**
315127	**Transport Pouch**
6065-00	***NovaCARD for Window*** , Data Archive Software (3½" diskette)
600026	**Power Cord** (N. America only

Catalog No.	Description
600075	**Cable**, BaseStation to Personal Computer (with 9-pin connector)
9086-00	**Cable**, BaseStation to Seiko DPU-414 Printer
9140-00	**Seiko DPU-414 Thermal Printer** w/Batter
400052	**AC Adapter for Seiko DPU-414 Printe** , 120 VAC
300017	**Thermal Printing Pape** , Seiko DPU-414 (5 rolls per box
6081-00	**Gas regulator**, for use with precision gas mixture, Cat. No. 8364-10
8364-10	**Precision gas mixture** for validation

Parts Lists

Final Assembly 9425-00, Model 615			
Seq	Item Nbr	Description	Quantity
001	6874-32	LABEL, SN & BTRY	1
002	6886-13	CARTON, SHIPPING	1
004	9026-32	LABEL, "MANUFACTURED IN USA"	1
005	9425-01	MAIN ASSY, 615	1
007	9425-09	OVERALL WIRING DIAGRAM	0
008	9425-23	USERS MANUAL	0
013	9409-32	LABEL, QUICK GUIDE	1
014	9341-32	WARN LABEL, AC PWR SUPPLY	1
020	160044	ALCOHOL, ISOPROPYL	0

Main Assembly 9425-01, Model 615			
Seq	Item Nbr	Description	Quantity
001	2754-01	MAIN BOARD ASSY, 615	1
002	6680-26	BOTTOM CVR W PAD PRINTING	1
003	6685-16	BATTERY DOOR	1
004	6823-10	FILLER, KEYPANEL	1
005	6838-10	GASKET	1
006	6839-10	GASKET	1
007	9422-27	MEMBRANE KEYPANEL, 615	1
008	9426-13	TOP COVER W PAD PRINTING,	1
009	9203-10	INSULATING SHIELD	1
010	9208-01	XDUCER ASSY, CAPNO II	1
011	9215-01	END PANEL ASSY	1
012	9187-10	FOAM PAD, TOP	1
013	9201-10	FOAM PAD, BOTTOM	1
016	160044	ALCOHOL, ISOPROPYL	0
017	161102	ADHESIVE, RTV162, SILICON	0
018	281211	SCREW, 2-56 X 1/4L	0
019	286223	SCREW, 6-32 x 3/8 IN	0

Main Assembly 9425-01, Model 615			
Seq	Item Nbr	Description	Quantity
020	482605	LCD DISPLAY	1
021	600076	RIBBON CABLE, 60 PIN	1
022	250166	PUMP	1
023	282024	SCREW, M2 X .4 X 8MM L	2
024	285050	SHOULDER WASHER, NYLON	2
025	161108	FOAM TAPE, 1/32THK x 3/4W	0

Main Board Assy 2754-01, Model 615			
Seq	Item Nbr	Description	Quantity
000	487100	IC, TC1426COA	1
000	475052	POTENTIOMETER, 1K OHM	1
000	474245	RESISTOR, 1M OHM, 1/16W,	6
000	213900	CONNECTOR, 60 PIN, HEADER	1
000	154106	CAPACITOR, 22PF, 50VD	2
000	474241	RESISTOR, 150K OHM, 1/16W	6
000	154111	CAPACITOR, 1UF, 16VDC, 5	7
000	486825	IC, LMC7101BIN5X, OP AMP	1
000	486346	IC, TC7SOOFTE85L	4
000	487129	IC, CPC15AFH, ABSOLUTE PR	1
000	474233	RESISTOR, 10K OHM, 1/16W	49
000	484569	VOLTAGE REGULATOR	1
000	484060	TRANSISTOR, MMBT3904T	1
000	474222	RESISTOR, 10 OHM, 1/16W	2
000	481554	DIODE, BAV70LT1, DUAL	4
000	154093	CAPACITOR, 68UF, 16VDC	7
000	481549	DIODE, MBRS140T3	6
000	152096	CAPACITOR, 220UF, 35V	9
000	486790	IC, TLE2022CD, DUAL OP AMP	4
000	486049	IC, MC68332GCFC20, 20M HZ	1
000	487115	IC, INSTR AMP, LOW POWER	1
000	180029	INDUCTOR, 50MHZ CUT-OFF	2
000	180043	FERRITE BEAD, 30 OHMS	4
000	180030	INDUCTOR-CAP, 4700PF, 50V	7
000	474242	RESISTOR, 249K OHM, 1/16W	1
000	474265	RESISTOR, 1 OHM, 1/4W, 1%	1
000	481555	DIODE, MMBD7000LT1, DUAL	11
000	486348	IC, MM74HC4040M, 12-STAGE	1
000	474227	RESISTOR, 1K OHM, 1/16W	15
000	486830	IC, QUAD OP AMP, ENHANCE	1

Main Board Assy 2754-01, Model 615			
Seq	Item Nbr	Description	Quantity
000	474229	RESISTOR, 2.05K OHM, 1/16	4
000	211425	CONNECTOR, 4 PIN, HEADER	1
000	154081	CAPACITOR, 100PF, 100V	2
000	2752-02	FAB, MAIN BOARD	1
000	154105	CAPACITOR, 47PF, 50VD	2
000	474238	RESISTOR, 37.4K OHM, 1/16	1
000	474259	RESISTOR, 15K OHM, 1/16W	3
000	486826	IC, LTCl448CS8	1
000	474249	RESISTOR, 215 OHMS, 1/16W	1
000	154103	CAPACITOR, .001UF, 50VDC	2
000	484567	VOLTAGE REGULATOR	1
000	154112	CAPACITOR, .047UF, l6VDC	73
000	486829	IC, LTClS90CS, DUAL 12-BIT	1
000	483019	TRANSISTOR, MMBT2907ALT1	1
000	487104	IC, TC4404COA	1
000	485541	TRANSISTOR, S14947DY	3
000	486827	IC, 12-BIT ANALOG TO DIG	1
000	474269	RESISTOR, 121K OHM, 1/16W	1
000	180045	INDUCTOR, 220UH, 20%, .53	2
000	486360	IC, SN74AHCT573DB, OCTAL	2
000	486796	IC, TLC2272CD, DUAL OP AMP	2
000	474257	RESISTOR, 1 OHM, .5 W, 1%	1
000	474199	RESISTOR, 16.5K OHM, 1/16	1
000	474299	RESISTOR PACK, 10K OHM	2
000	474247	RESISTOR, lOM OHM, 1/16W	1
000	486805	IC, LM393M, DUAL VOLTAGE	1
000	482551	LED, RED, WITH LENS	1
000	474250	RESISTOR, 43.2K OHM, 1/16	1
000	486785	IC, LP339M, QUAD VOLTAGE	1
000	486051	IC, 131K X 8 BIT RAM, 85N	1
000	474284	RESISTOR, 115 OHM, 1/16W	1
000	484573	VOLTAGE REGULATOR	1
000	230024	CRYSTAL, 32.768 KHZ	1
000	2739-01	BTRY & COMM INTFC BD ASSY	1
000	474231	RESISTOR, 4.99K OHM, 1/16	5
000	474256	RESISTOR, 0 OHM	5
000	474240	RESISTOR1 100K OHM, 1/16W	20
000	474261	RESISTOR, 7.5K OHM, 1/16W	2
000	474251	RESISTOR, 61.9K OHM, 1/16	3
000	154086	CAPACITOR, 4.7UF, 10VDC	4

Main Board Assy 2754-01, Model 615			
Seq	Item Nbr	Description	Quantity
000	481546	DIODE, SWITCHING, SURF MT	13
000	481547	DIODE, BAT54, HOT CARRIER	4
000	474194	RESISTOR, 2.2M OHM, 1/16W	2
000	474197	RESISTOR, 49.9K OHM, 1/16	13
000	484562	IC, LT1175CS8-ADJ, MICROP	2
000	215073	SOCKET, PLCC, 32 PIN	1
000	474294	RESISTOR, 237K OHM, 1/16W	1
000	484563	IC, LT1117CST, VOLTAGE RG	2
000	180022	INDUCTOR, 10UH, 10%	6
000	487132	IC, TL7757CPK	1
000	486807	IC, SMP04ES, QUAD SAMPLE	1
000	154113	CAPACITOR, 4700PF, 50VDC	2
000	474266	RESISTOR, 4~75K OHM, 1/8w	1
000	180054	INDUCTOR, 1.5K OHMS	1
000	474230	RESISTOR, 3.32K OHM, 1/16	2
000	485543	TRANSISTOR, MOSFET, N-CHAN	3
000	6837-10	GASKET	1
000	474239	RESISTOR, 75K OHM, 1/16W	5
000	474198	RESISTOR, 2.49K OHM, 1/16	4
000	154108	CAPACITOR, 100PF, 50VDC	20
000	474298	RESISTOR, 34K OHM, 1/16W	1
000	515092	FUSE, 3A, 32V	1
000	210141	CONNECTOR, DC PWR JACK	1
000	481552	DIODE, MBRS340T3, SCHOTTK	3
000	474224	RESISTOR, 100 OHM, 1/16W	57
000	474283	RESISTOR, 392K OHM, 1/16W	1
000	154072	CAPACITOR, .1UF, 50V, 10%	17
000	475045	E2 POTENTIOMETER, 10K OHM	1
000	486359	IC, LT1384CG	1
000	154095	CAPACITOR, 22UF, 20VDC	2
000	154104	CAPACITOR, .01UF, 50VDC	23
000	130017	TRANSDUCER, AUDIO, 2300 H	1
000	474213	RESISTOR, 10.2K OHM, 1/16	1
000	486828	IC, LT1460HCS3-2.5	1
000	487133	IC, REAL TIME CLK	1
000	486321	IC, SN74HC138D	1
000	154079	CAP, lOuF, 25V, 10%, TANT	7
000	216029	TEST POINT, SPRING LOADED	8
000	560009	TRANSFORMER, 10UH 20%	1
000	211233	CONNECTOR, 2 PIN, HEADER	1

Main Board Assy 2754-01, Model 615			
Seq	Item Nbr	Description	Quantity
000	154116	CAPACITOR, lOUF, 35V, 10%	2
000	474234	RESISTOR, 20.5K OHM, 1/16	2
000	400047	BATTERY, 3V, 190N AH, LITH	1
000	474225	RESISTOR, 499 OHM1 1/16w	7
000	487103	IC, TC4405COA	1
000	513010	SWITCH, SLIDE, SPDT, 4 5W	1
000	474243	RESISTOR, 324K OHM, 1/16W	2
000	485532	TRANSISTOR, 2N7002T1, N-C	14
000	474236	RESISTOR, 33.2K OHM, 1/16	3
000	474235	RESISTOR, 24.9K OHN, 1/16	5
000	486823	IC, LT1490CS8	3
000	474270	RESISTOR, 200K OHM, 1/16w	4
000	474332	RESISTOR, 6.04K OHM, 1/16	1
000	474333	RESISTOR, 210K OHM, 1/16W	1
000	2754-03	SCHEMATIC, MAIN BOARD	0
000	9475-07	PRGM, BOOT CODE & SYS CODE	1

Transducer Assy 9208-01, CAPNOSTAT® CO_2 Sensor			
Seq	Item Nbr	Description	Quantity
001	2753-01	INTERFACE BOARD ASSY	1
002	9208-09	OVERALL WIRING DIAGRAM	0
003	6809-17	CABLE PREPARATION, CAPN	1
003	9369-01	CABLE ASSY, XDCR, 610	1
03A	6809-17	CABLE PREPARATION, CAPN	1
03A	9369-01	CABLE ASSY, XDCR, 610	0
004	7125-32	LABBL, SERIAL NUMBER	1
005	7143-16	RETAINING CAP	1
006	7168-01	INTEGRATED SUBASSY (ISA)	1
007	7187-26	TRANSDUCER HOUSING	1
008	7188-13	TRANSDUCER HOUSING SHIELD	1
015	161098	TAPE, KAPTON, 3/8 W X .00	0
016	280210	0-RING, .239 ID X .025 W	1
017	280211	0-RING, .472 ID X .024 W	1
017	280226	0-RING, .472 ID X .024 W	0
018	280232	SPRING CONTACT, SELF-ADHV	2
019	320039	SOLDER, 63% TIN-37% LEAD	0
020	608001	CABLE TIE, .094 X 3.62L	0
021	608007	TUBING, HEAT SHRINK, 1/4 IN	0
022	608005	TUBING, HEAT SHRINK, 1/16 FT	0

Transducer Assy 9208-01, CAPNOSTAT® CO_2 Sensor			
Seq	Item Nbr	Description	Quantity
023	315097	BAG, STATIC SHIELDING	1
024	315098	LABEL, ESD, REUSABLE	1

Interface Board Assy 2753-01			
Seq	Item Nbr	Description	Quantity
000	213900	CONNECTOR, 60 PIN, HEADER	1
000	482604	LED, BICOLOR, RED & GREEN	1
000	180034	FERRITE FILTER, 4 LIN	1
000	484060	TRANSISTOR, MMBT3904T	2
000	211518	CONNECTOR, 5 PIN, RIGHT	1
000	481549	DIODE, MBRSl40T3, RECT	2
000	152096	CAPACITOR, 220UF, 35V	1
000	180030	INDUCTOR-CAP, 4700PF, 50V	3
000	474278	RESISTOR, 237K OHM, 1/8W	1
000	474220	RESISTOR, ZERO OHM, 1/4W	4
000	474263	RESISTOR, 28K OHM, 1/8W	1
000	486042	IC, AT93C66-10SC	1
000	474279	RESISTOR, 562 OHM, 1/8W	1
000	180046	INDUCTOR, 18UH @ 2.5M HZ	1
000	482602	LED, GREEN, ROUND, .100	1
000	213411	CONNECTOR, 40 PIN, RCPT	1
000	280235	SPACER, LED, FOR 2 LEAD	1
000	474182	RESISTOR, 150K OHM, 1/8W	1
000	474282	RESISTOR, 4.64K OHM, 1/8W	1
000	474174	RESISTOR, 332 OHM, 1/8W	6
000	486820	IC, BQ2004SN, FAST CHARGE	1
000	474280	RESISTOR, 243 OHMS, 1/8W	1
000	515085	FUSE W FUSEHOLDER, 2A	1
000	154099	CAPACITOR, 68UF, 20VDC	2
000	154078	CAPACITOR, 1000PF, 50VDC	1
000	474161	RESISTOR, 5.9K OHM, 1/8W	1
000	481546	DIODE, SWITCHING, SURF MT	3
000	474170	RESISTOR, 301K OHM, 1/8W	2
000	180035	FERRITE FILTER, 8 LINE	2
000	474281	RESISTOR, 71.5K OHM, 1/8W	1
000	481045	DIODE, ZENER, BZT52-C5V1	1
000	180022	INDUCTOR, 10UH, 10%	1
000	474277	RESISTOR, .15 OHM, 1/2W	1
000	515087	FUSE W FUSEHOLDER, IA	1

Interface Board Assy 2753-01			
Seq	Item Nbr	Description	Quantity
000	154072	CAPACITOR, .1UF, 50V, 10%	8
000	482601	LED, YELLOW, ROUND, .100	1
000	280233	SPACER, LED, FOR 2 LEADS	1
000	482603	LED, BICOLOR, RED/YELLOW	1
000	216029	TEST POINT, SPRING LOADED	1
000	154116	CAPACITOR, lOUF, 3SV	2
000	211639	CONNECTOR, 6 PIN, RCPT	1
000	2753-03	SCHEMATIC, INTERFACE BOA	0
000	483020	TRANSISTOR, FMMT7l7, PNP	1
000	474136	RESISTOR, 1K OHM, 1/8W	3
000	280234	SPACER, LED, FOR 3 LEADS	2
000	2753-02	FAB, INTERFACE BOARD	1
001	154079	CAP, 10uF, 25V, 10%, TANT EA	2

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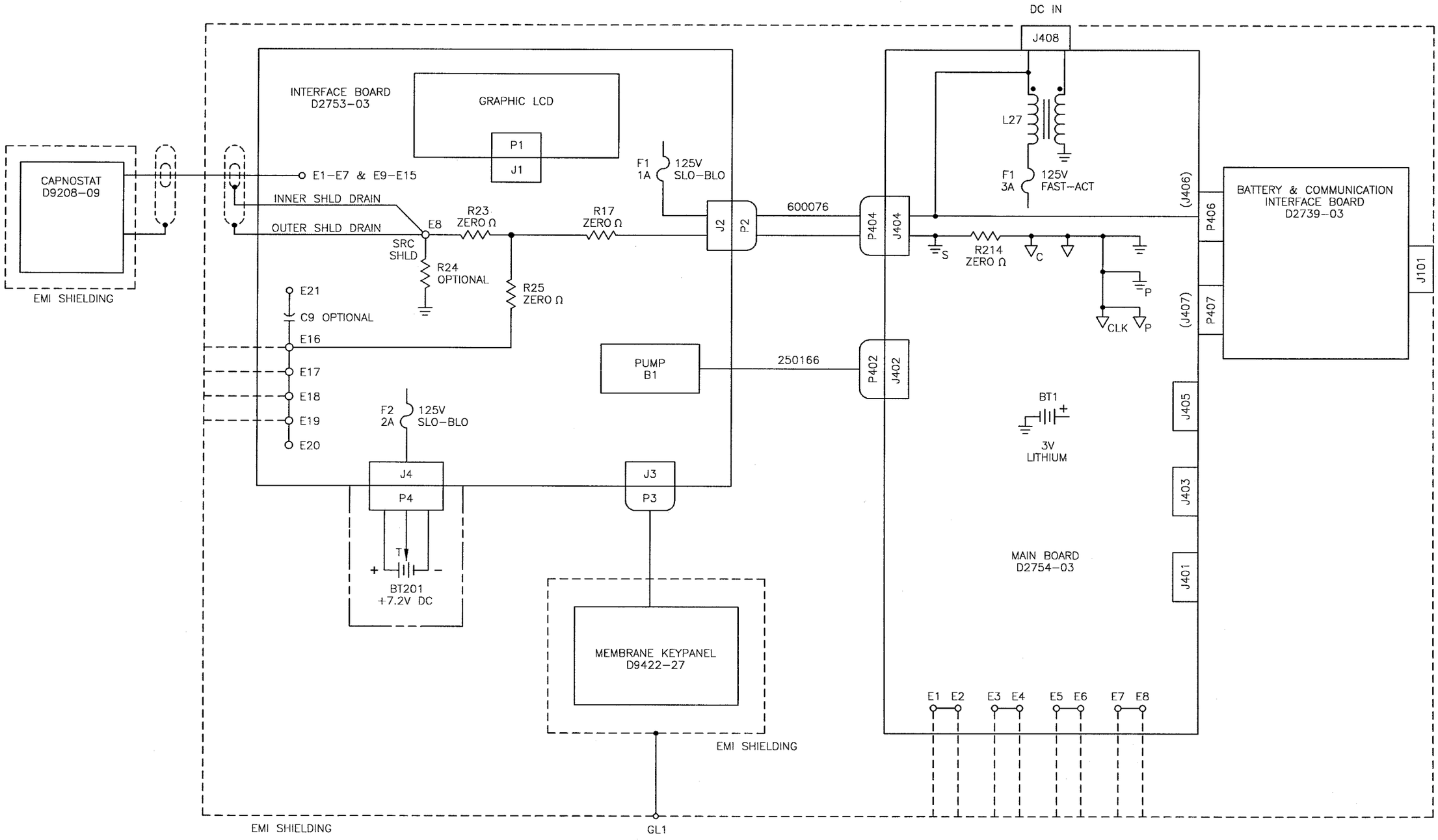
Drawings

Drawing No.	Code	Description	Sheets
9425	09	Overall Wiring Diagram, Model 615	1
9208	09	Overall Wiring Diagram, Transducer Assy, CAP-NOSTAT® III, Model 615	1
9425	00	Final Assembly, Model 615	1
9425	01	Main Assy, Model 615	3
2753	01	Interface Board Assy, Model 615	1
2753	03	Interface Board Schematic, Model 615	1
2754	01	Main Board Assy, Model 615	3
2754	03	Main Board Schematic	8



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REV	R NO.	DATE

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DIMENSIONS ARE IN INCHES [mm]

TOLERANCES
XX ±.01 [.254]
XXX ±.005 [.127]
XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

DRAWN	Russell A. Griffith	DATE 17Mar99
CHECK	MRL	DATE
MFG ENGR	T. Carroll	DATE 5Apr99
ENGR	~	DATE
PROJ ENGR	A. J. Esposito	DATE 5Apr99

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: OVERALL WIRING DIAGRAM, 615

SIZE	DRAWING NO.	CODE	REV
D	9425	09	00

NEXT ASSY: D9425-00 | SCALE: 1/1 | SHEET 1 OF 1

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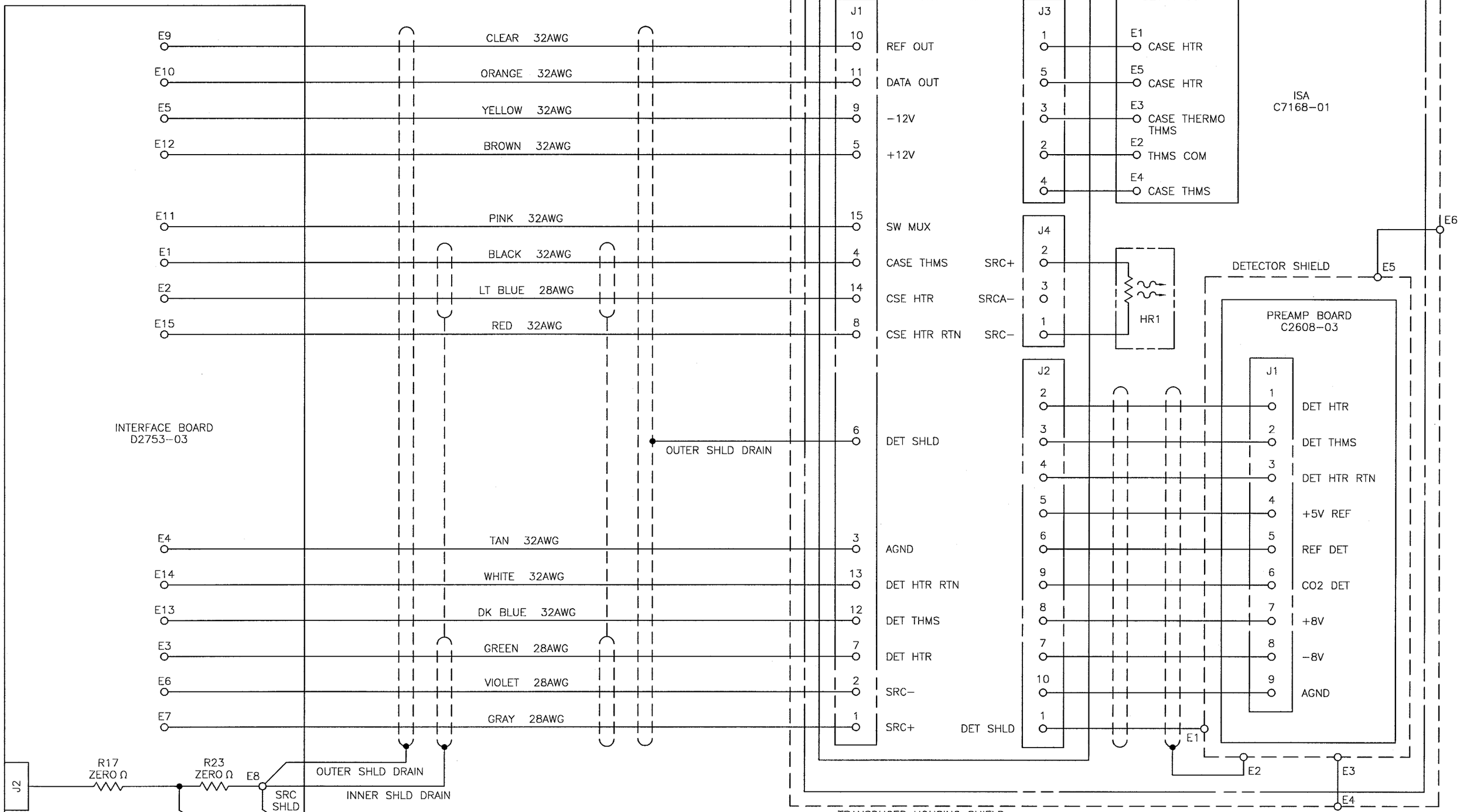
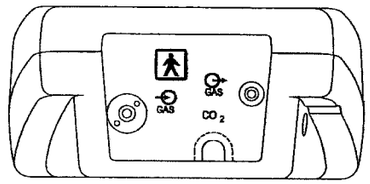
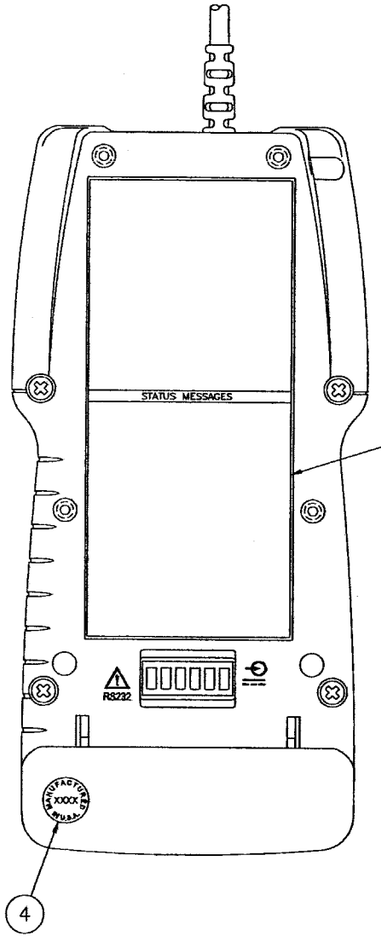


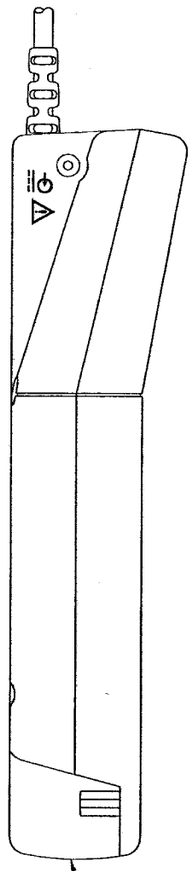
REV	R NO.	DATE	DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES BREAK ALL SHARP EDGES	TITLE: OVERALL WIRING DIAGRAM, TRANSDUCER, CAPNOSTAT III, 710 & 715 – TIDALWAVE SP	NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492
			TOLERANCES: .X ±.02, .XX ±.01, .XXX ±.005, .XXXX ±.0010, FRAC ±1/64, ANG ±1/4°	DRAWN BL 3Jun98 / CHECKED MRL 3Jun98	SIZE D / DRAWING NO. 9208 / CODE 09 / REV 00
			MATERIAL ~	MFG ENGR TJC 21Sep98 / APPROVED AJE 21Sep98	
			FINISH ~	USED ON: D6809-17	SCALE: NONE / SHEET 1 OF 1



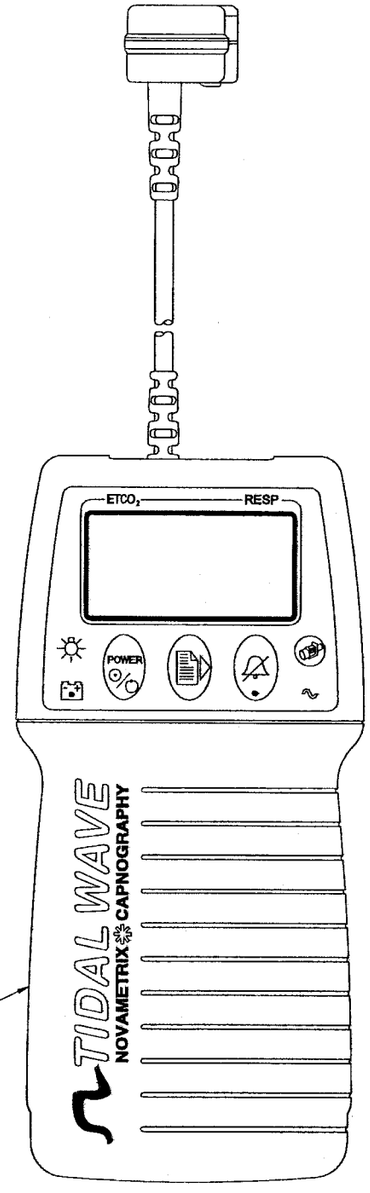


13 LOCATE IN RECESS

4



SEE DETAIL A FOR SN LABEL LOCATION



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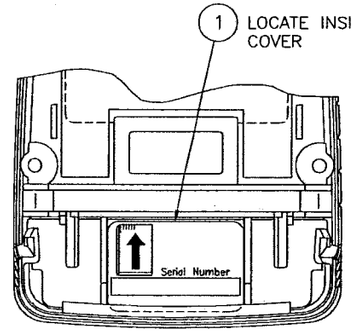

DETAIL A

NOTES:

1. FOR SYSTEM TEST PROCEDURE SEE A9425-04.
2. FOR QA TEST PROCEDURE SEE A9425-70.
3. FOR OVERALL WIRING DIAGRAM SEE D9425-09.
4. WIPE UNIT WITH IPA, ITEM 20 BEFORE APPLYING LABELS. NOTE ORIENTATION AND LOCATE LABELS APPROXIMATELY AS SHOWN.
5. THE FOLLOWING ITEMS ARE TO BE INCLUDED WITH MONITOR. REFER TO SHIPPING INSTRUCTIONS.
   A. ITEM 8: USERS MANUAL; QTY: 1
   B. ITEM 14: INSTRUCTION SHEET WARNING LABEL, AC POWER SUPPLY; QTY: 1

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TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

REV	R NO.	DATE

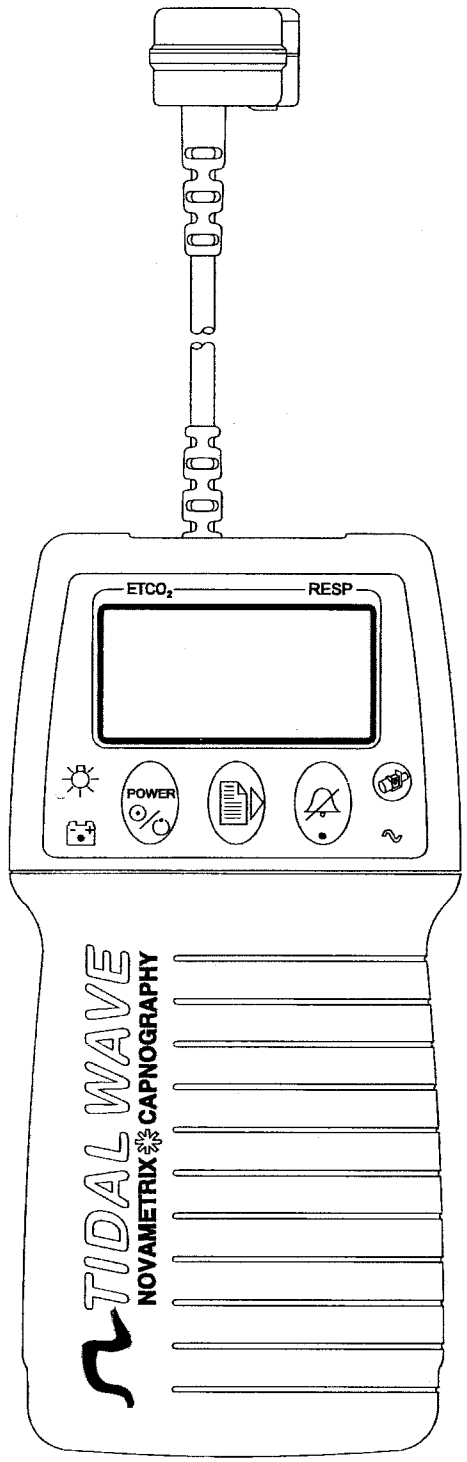
DRAWN	Russell G. Griffith 16Mar99
CHECK	DATE
MFG ENGR	DATE
ENGR	DATE
PROJ ENGR	DATE 23JUN99
NEXT ASSY:	

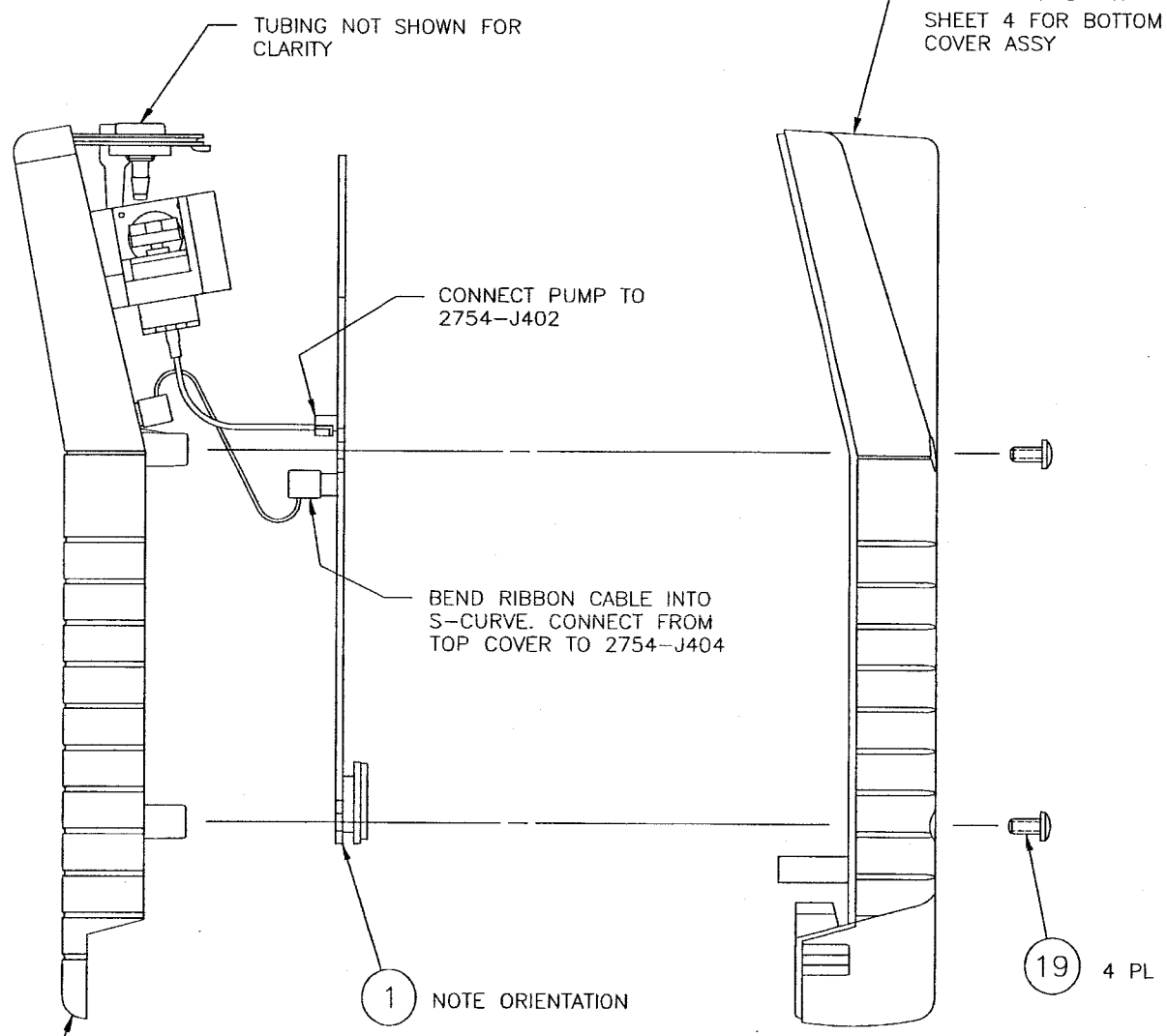
NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: ETCO2 WITH SIDESTREAM MONITOR, 615

SIZE	DRAWING NO.	CODE	REV
D	9425	00	00

SCALE: NONE SHEET 1 OF 1




TUBING NOT SHOWN FOR CLARITY
SEE DETAIL C ON SHEET 4 FOR BOTTOM COVER ASSY
CONNECT PUMP TO 2754-J402
BEND RIBBON CABLE INTO S-CURVE. CONNECT FROM TOP COVER TO 2754-J404
1 NOTE ORIENTATION
19 4 PL

SEE DETAIL A ON SHEET 2 FOR TOP COVER ASSY

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TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

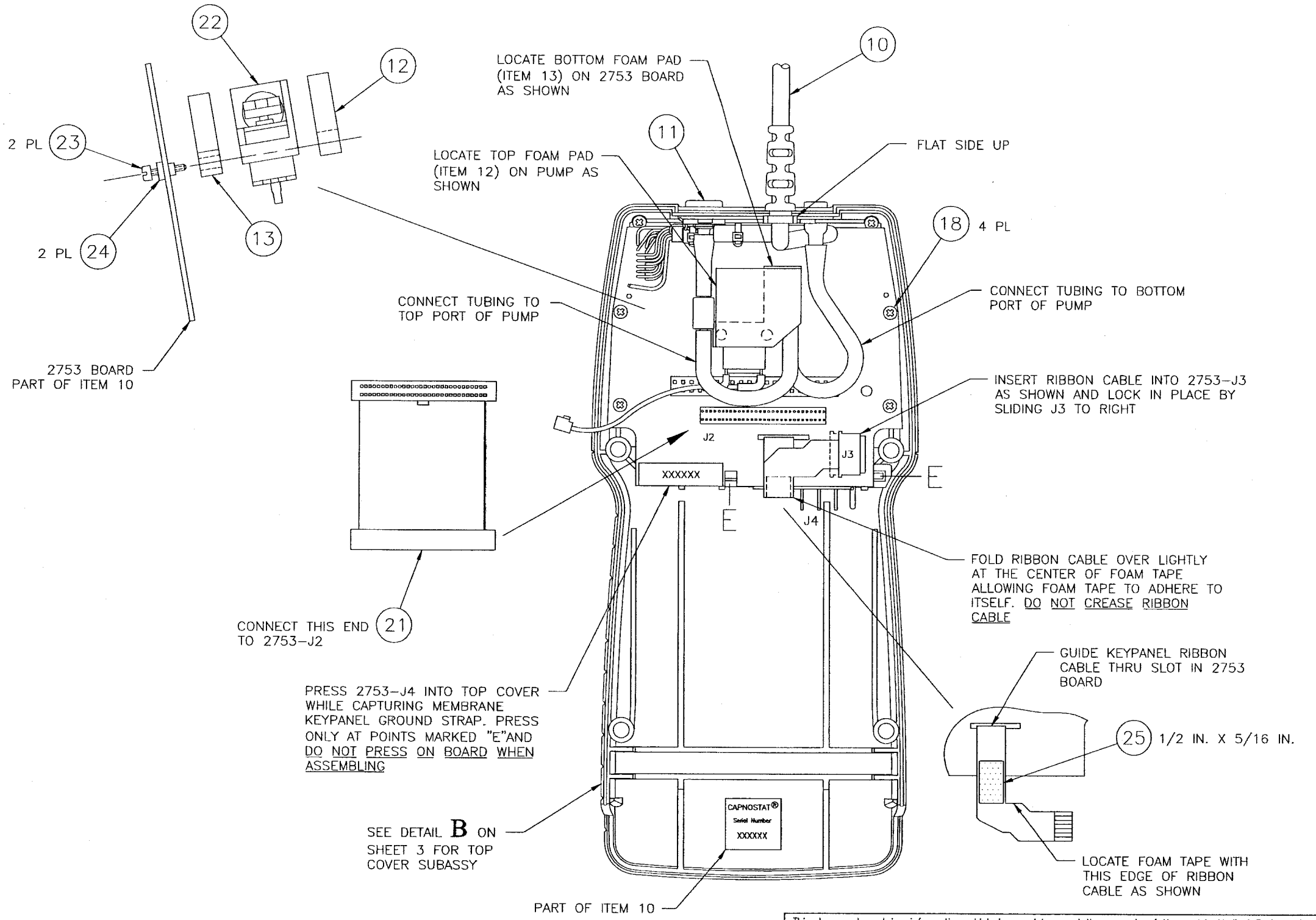
DRAWN	Russell G. Griffith	DATE 15Mar99
CHECK		DATE 22 Jun 99
MFG ENGR		DATE 7/21/99
ENGR		DATE 7/21/99
PROJ ENGR		DATE 7/22/99
NEXT ASSY: 09425-00		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN ASSY, 615

SIZE	DRAWING NO.	CODE	REV
C	9425	01	00

SCALE: 1/1 SHEET 1 OF 4


22
12
2 PL 23
2 PL 24
13
2753 BOARD
PART OF ITEM 10
LOCATE BOTTOM FOAM PAD (ITEM 13) ON 2753 BOARD AS SHOWN
10
11
LOCATE TOP FOAM PAD (ITEM 12) ON PUMP AS SHOWN
FLAT SIDE UP
18 4 PL
CONNECT TUBING TO TOP PORT OF PUMP
CONNECT TUBING TO BOTTOM PORT OF PUMP
INSERT RIBBON CABLE INTO 2753–J3 AS SHOWN AND LOCK IN PLACE BY SLIDING J3 TO RIGHT
J2
J3
J4
XXXXXX
E
E
FOLD RIBBON CABLE OVER LIGHTLY AT THE CENTER OF FOAM TAPE ALLOWING FOAM TAPE TO ADHERE TO ITSELF. DO NOT CREASE RIBBON CABLE
CONNECT THIS END 21 TO 2753–J2
PRESS 2753–J4 INTO TOP COVER WHILE CAPTURING MEMBRANE KEYPANEL GROUND STRAP. PRESS ONLY AT POINTS MARKED "E"AND DO NOT PRESS ON BOARD WHEN ASSEMBLING
GUIDE KEYPANEL RIBBON CABLE THRU SLOT IN 2753 BOARD
25 1/2 IN. X 5/16 IN.
SEE DETAIL B ON SHEET 3 FOR TOP COVER SUBASSY
CAPNOSTAT®
Serial Number
XXXXXX
LOCATE FOAM TAPE WITH THIS EDGE OF RIBBON CABLE AS SHOWN
PART OF ITEM 10
DETAIL A

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TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

REV	R NO.	DATE

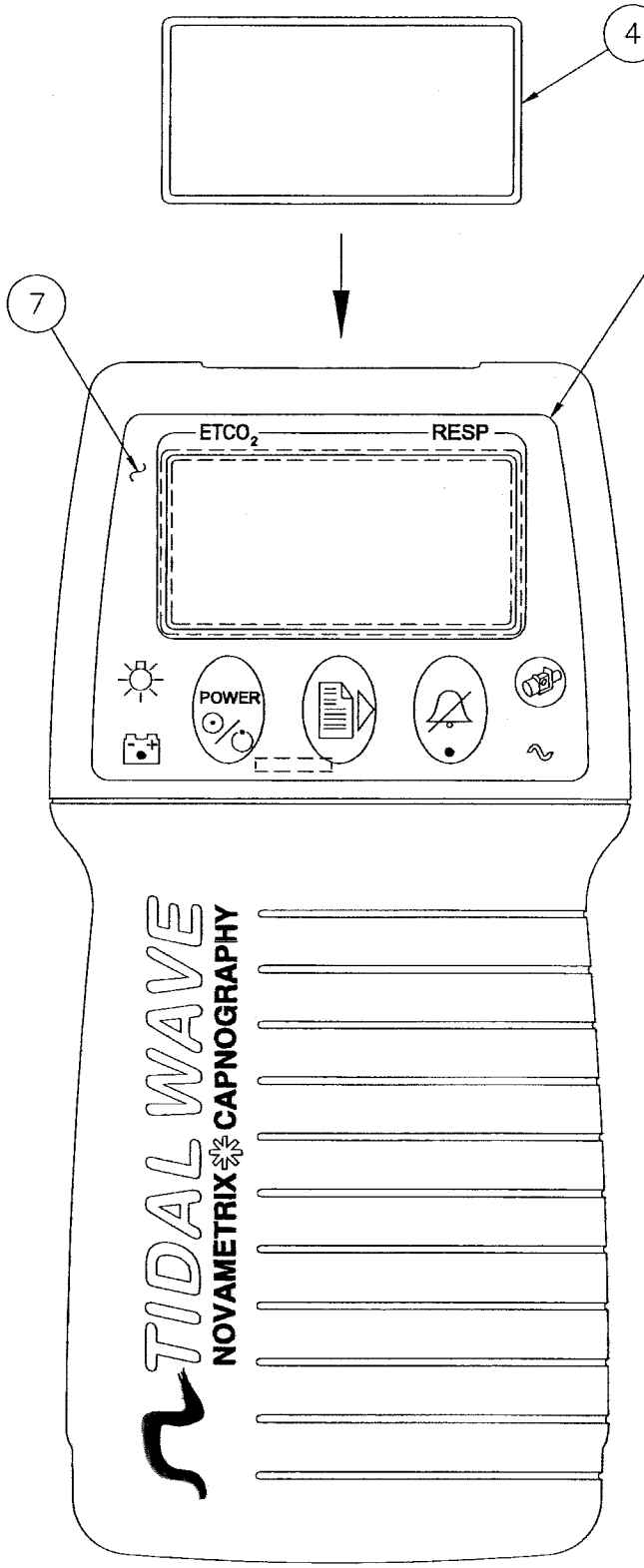
DRAWN	Russell A. Griffith	DATE 15Mar99
CHECK		DATE 22 JUL 99
MFG ENGR		DATE 7/21/99
ENGR		DATE 7/21/99
PROJ ENGR		DATE 7/22/99
NEXT ASSY: D9425-00		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN ASSY, 615

SIZE	DRAWING NO.	CODE	REV
C	9425	01	00

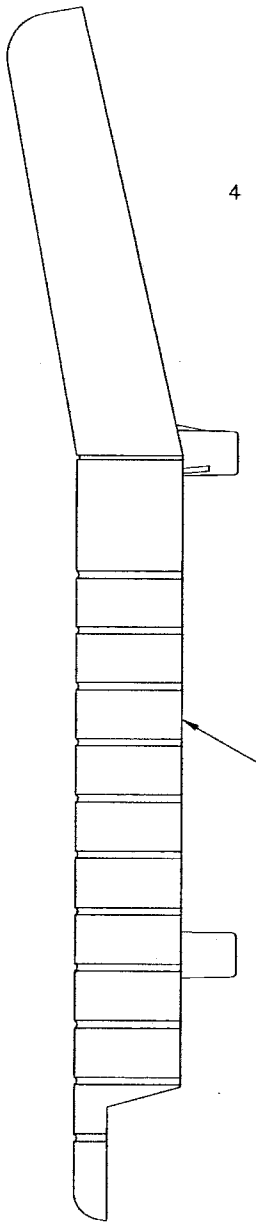
SCALE: NONE SHEET 2 OF 4



4 INSTALL FROM FRONT BEFORE KEYPANEL

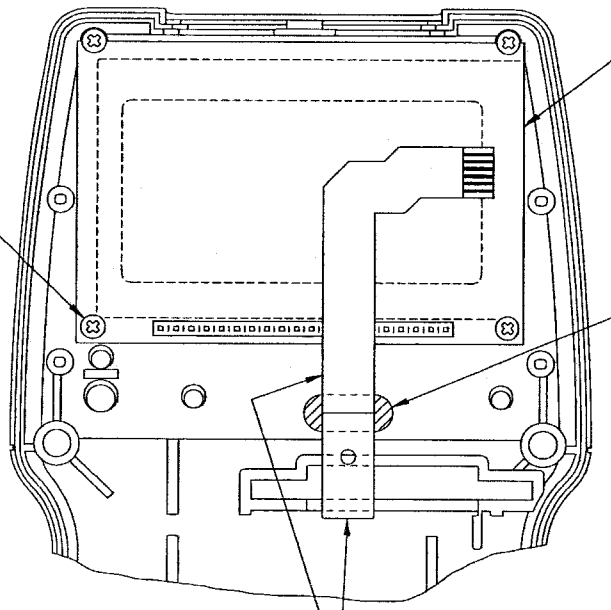
16 CLEAN KEYPANEL RECESS AND ALLOW TO DRY

7



8

DETAIL B



4 PL 18

20 NOTE ORIENTATION

17 APPLY A BEAD OF RTV COMPLETELY AROUND GROUND STRAP, RIBBON CABLE AND SLOT ENSURING THAT ALL VOIDS ARE FILLED. CURE AT ROOM TEMPERATURE FOR 24 HOURS

GUIDE RIBBON CABLE AND GROUND STRAP THRU SLOT IN TOP COVER

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REV	R NO.	DATE

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TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

DRAWN	Russell G. Griffith	DATE 15Mar99
CHECK		DATE
MFG ENGR		DATE
ENGR		DATE
PROJ ENGR		DATE 7/22/99

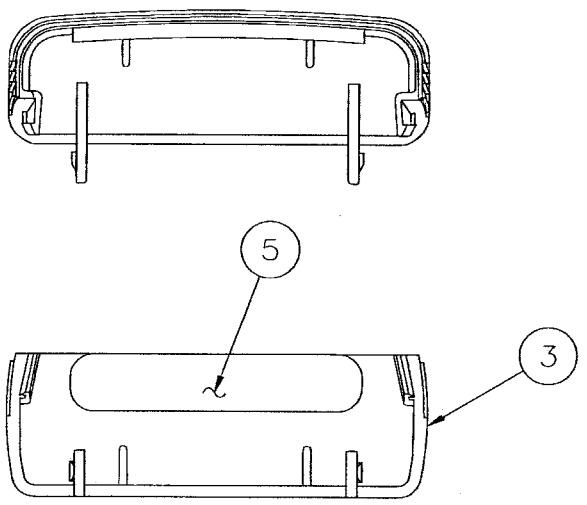
NEXT ASSY: D9425-00

NOVAMETRIX MEDICAL SYSTEMS INC.

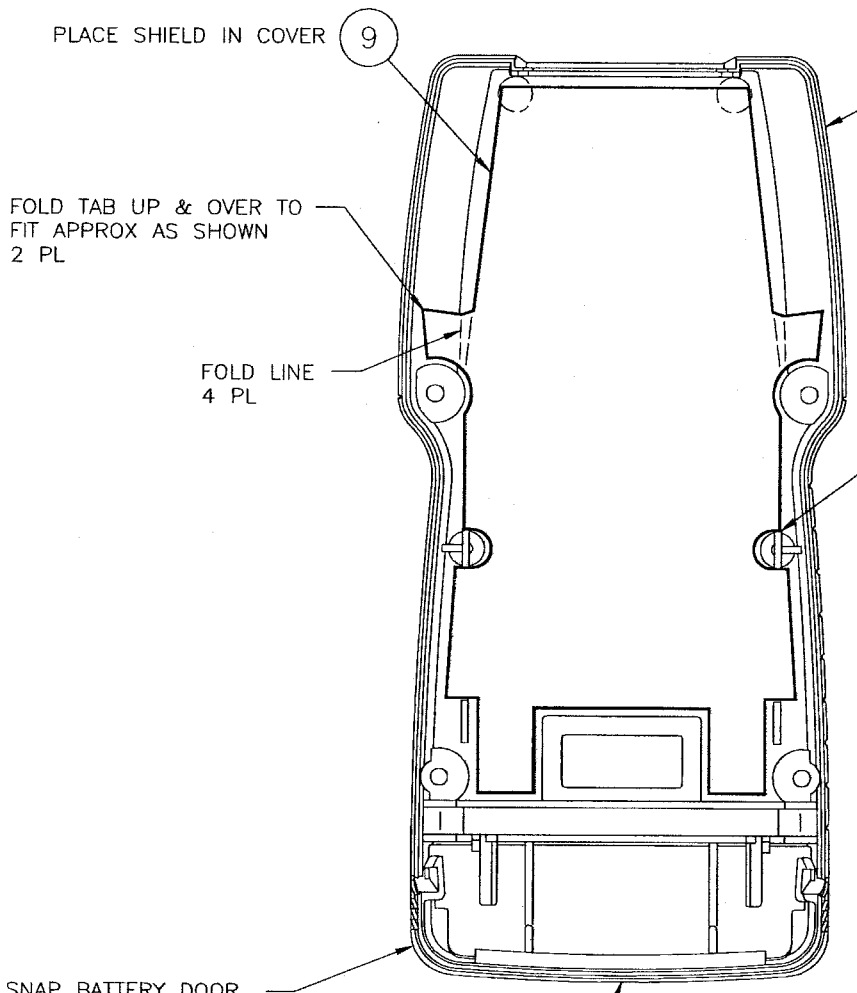
TITLE: MAIN ASSY, 615

SIZE	DRAWING NO.	CODE	REV
C	9425	01	00

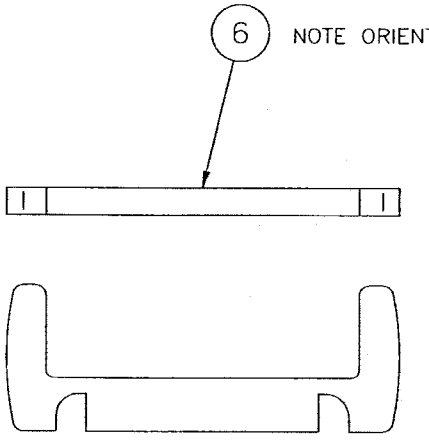
SCALE: NONE | SHEET 3 OF 4



DETAIL D


PLACE SHIELD IN COVER
9
2
FOLD TAB UP & OVER TO FIT APPROX AS SHOWN 2 PL
FOLD LINE 4 PL
PRESS SHIELD DOWN AROUND BOSS ON BOTH SIDES
SNAP BATTERY DOOR ONTO BOTTOM COVER
SEE DETAIL D FOR BATTERY DOOR SUBASSY

DETAIL C



BOTTOM SIDE

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REV	R NO.	DATE

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

DRAWN	Russell G. Griffith	15Mar99
CHECK	MKL	22JUL99
MFG. ENGR	MKL	7/21/99
ENGR	[illegible]	7/22/99
PROJ ENGR	[illegible]	7/22/99
NEXT ASSY: D9425-00		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN ASSY, 615

SIZE	DRAWING NO.	CODE	REV
C	9425	01	00

SCALE: 1/1 SHEET 4 OF 4

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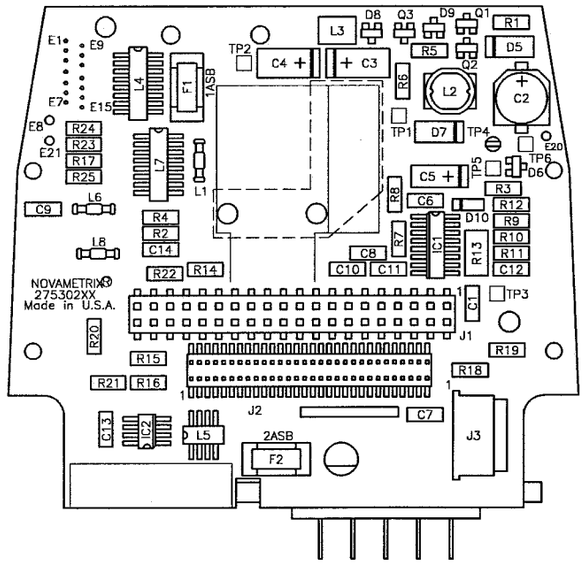
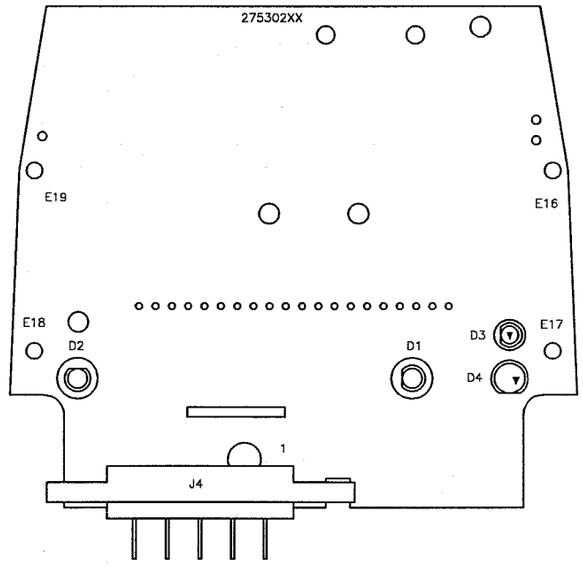




PN	DESCRIPTION	REF DES
2753-02	FAB, INTERFACE BOARD, MODEL 710 & 715	~
D2753-03	SCHEMATIC, INTERFACE BOARD, 710 & 715	~
A2753-48	ASSY FIXTURE, BATTERY CONNECTOR	(FOR J4)
152096	CAPACITOR, 220uF, 35V, 20%, ELECTROLYTIC	C2
154072	CAPACITOR, .1uF, 50V, 10%	C1, C6-C8, C10, C11, C13, C14
154078	CAPACITOR, 1000pF, 50VDC, 10%, NPO	C12
154079	CAPACITOR, 10uF, 25V, 10%, TANTALUM	C5
154116	CAPACITOR, 10uF, 35V, 10%	C3, C4
180022	INDUCTOR, 10uH, 10%	L3
180030	INDUCTOR-CAP, 4700pF, 50VDC, 2A, 3 TERMINAL	L1, L6, L8
180034	FERRITE FILTER, 4 LINE, EMI SUPPRESSION	L5
180035	FERRITE FILTER, 8 LINE, EMI SUPPRESSION	L4, L7
180046	INDUCTOR, 18uH @ 2.5MHz, +25% -15%	L2
☆ 211518	CONNECTOR, 5 PIN, RIGHT ANGLE	J4
☆ 211639	CONNECTOR, 6 PIN, RECEPTACLE, ZIF, R ANGLE	J3
213411	CONNECTOR, 40 PIN, RECEPTACLE, STRAIGHT	J1
213900	CONNECTOR, 60 PIN, HEADER, .05 X .1 SPACING	J2
☆ 216029	TEST POINT, SPRING LOADED, 475'C MAX	TP4
280233	SPACER, LED, FOR 2 LEADS, .2 DIA X .1 LONG	(FOR D4)
280234	SPACER, LED, FOR 3 LEADS, .255 DIA X .185 L	(FOR D1, D2)
280235	SPACER, LED, FOR 2 LEADS, .25 DIA X .2 LONG	(FOR D3)
474136	RESISTOR, 1k OHM, 1/8W, 1%	R1, R5, R11
474161	RESISTOR, 5.9k OHM, 1/8W, 1%	R9
474170	RESISTOR, 301k OHM, 1/8W, 1%	R10, R14
474174	RESISTOR, 332 OHM, 1/8W, 1%	R15, R16, R18-R21
474182	RESISTOR, 150k OHM, 1/8W, 1%	R4
474220	RESISTOR, ZERO OHM, 1/4W, 5%	R17, R22, R23, R25
474263	RESISTOR, 28k OHM, 1/8W, 1%	R8
474277	RESISTOR, .15 OHM, 1/2W	R13
474278	RESISTOR, 237k OHM, 1/8W, 1%	R2
474279	RESISTOR, 562 OHM, 1/8W, 1%	R3
474280	RESISTOR, 243 OHM, 1/8W, 1%	R6
474281	RESISTOR, 71.5k OHM, 1/8W, 1%	R7
474282	RESISTOR, 4.64k OHM, 1/8W, 1%	R12
481045	DIODE, ZENER, 5.1V	D10
481546	DIODE, SWITCHING	D6, D8, D9
481549	DIODE, RECTIFIER	D5, D7
☆ 482601	LED, YELLOW, ROUND, .100 SPACING	D3
☆ 482602	LED, GREEN, ROUND, .100 SPACING	D4
☆ 482603	LED, BICOLOR, RED/YELLOW, ROUND, 3 LEAD	D1
☆ 482604	LED, BICOLOR, RED/GREEN, ROUND, 3 LEAD	D2
483020	TRANSISTOR, PNP, SOT23 CASE	Q1
484060	TRANSISTOR, NPN	Q2, Q3
486042	IC, SERIAL 4k EEPROM, 8 PIN	IC2
486820	IC, FAST CHARGE, 16 PIN	IC1
515085	FUSE WITH FUSEHOLDER, 2A, 125V, SLO-BLO	F2
515087	FUSE WITH FUSEHOLDER, 1A, 125V, SLO-BLO	F1

NOTES:

1. D2753-01 SPECIFICATIONS:
   A. COMPONENTS NOT FITTED: C9, R24
   B. ☆ DENOTES THRU HOLE COMPONENTS.
   C. TRIM COMPONENT LEADS FLUSH WITH PC BOARD.
   D. FOR J4 ASSY FIXTURE USE 2753-48.

REV	R NO.	DATE	DESCRIPTION
			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES BREAK ALL SHARP EDGES
			.X ±.02 TOLERANCES .XX ±.01 .XXX ±.005 FRAC ±1/64 .XXXX ±.0010 ANG ±1/4°
			MATERIAL ~
01	N631	29Jan99	FINISH ~

TITLE: INTERFACE BOARD ASSY, MODEL 710 & 715 - TIDAL WAVE SP

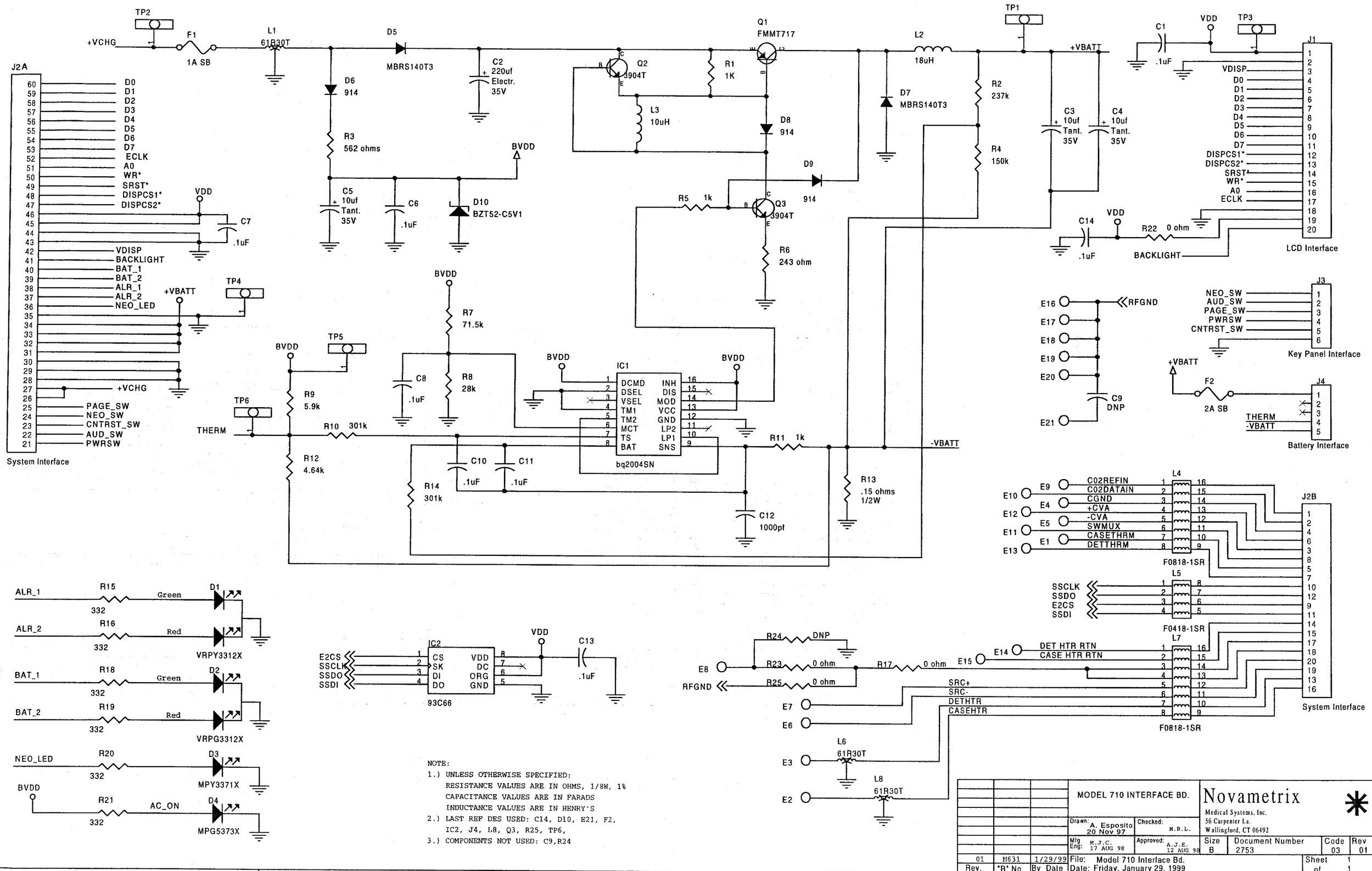
NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492

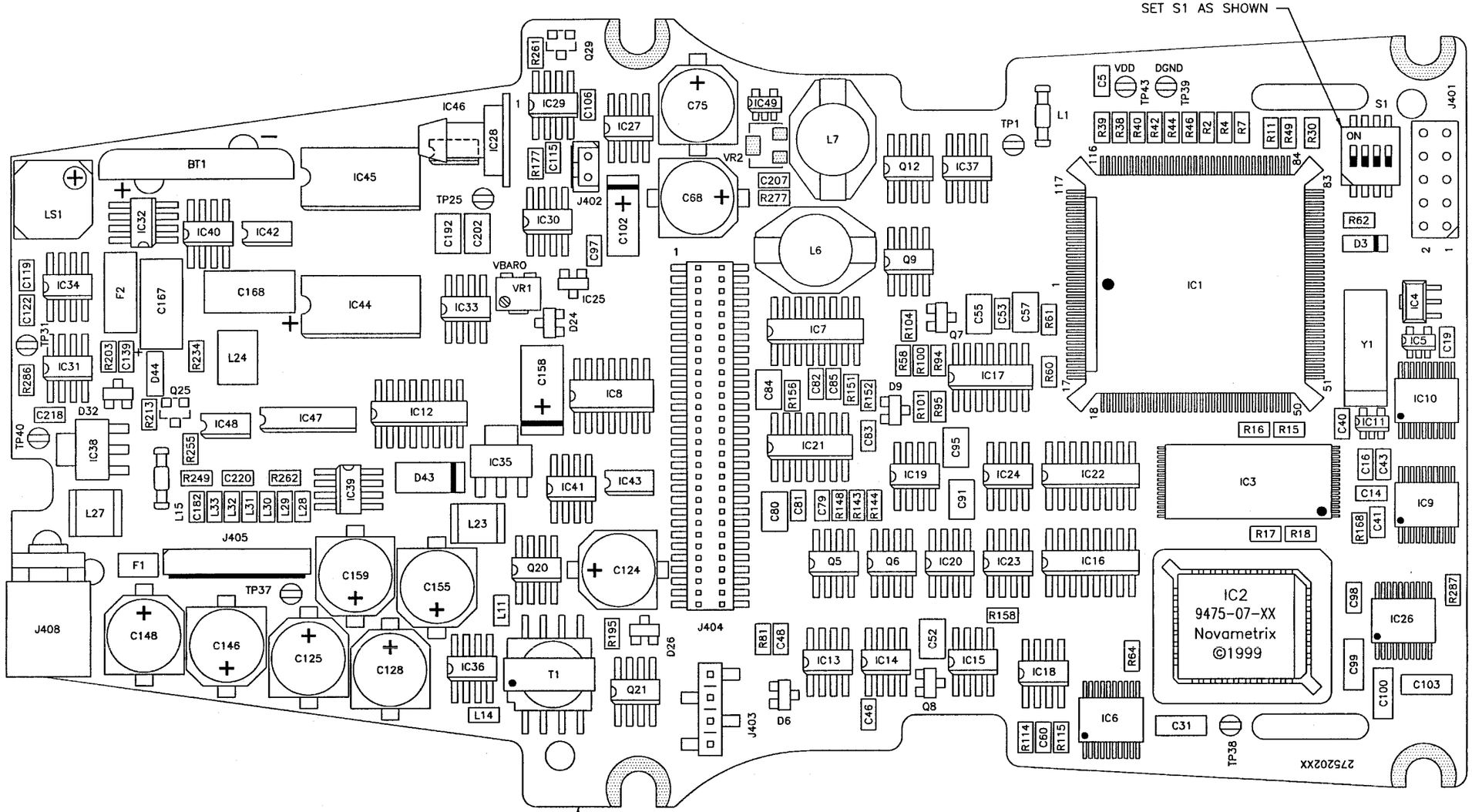
DRAWN	CHECKED
BL 14May98	MRL 2Sep98
MFG ENGR TJC 2Sep98	APPROVED AJE 3Sep98

USED ON: D9208-01

SIZE	DRAWING NO.	CODE	REV
D	2753	01	01

SCALE: 2/1 SHEET 1 OF 1


J2A
System Interface
D0
D1
D2
D3
D4
D5
D6
D7
ECLK
A0
WR*
SRST*
DISPCS1*
DISPCS2*
VDISP
BACKLIGHT
BAT_1
BAT_2
ALR_1
ALR_2
NEO_LED
PAGE_SW
NEO_SW
CNTRST_SW
AUD_SW
PWRSW
+VCHG
TP2
F1
1A SB
L1
61R30T
D5
MBRS140T3
C2
220uf
Electr.
35V
D6
914
R3
562 ohms
C5
10uf
Tant.
35V
C6
.1uF
D10
BZT52-C5V1
BVDD
VDD
C7
.1uF
TP4
+VBATT
TP5
TP6
THERM
R9
5.9k
R10
301k
R12
4.64k
R14
301k
R7
71.5k
C8
.1uF
R8
28k
C10
.1uF
C11
.1uF
IC1
DCMD
DSEL
VSEL
TM1
TM2
MCT
TS
BAT
INH
DIS
MOD
VCC
GND
LP2
LP1
SNS
bq2004SN
Q1
FMMT717
Q2
3904T
R1
1K
L3
10uH
D8
914
D9
914
R5
1k
Q3
3904T
R6
243 ohm
R11
1k
C12
1000pf
R13
.15 ohms
1/2W
-VBATT
L2
18uH
D7
MBRS140T3
TP1
R2
237k
R4
150k
+VBATT
C3
10uf
Tant.
35V
C4
10uf
Tant.
35V
C1
.1uF
VDD
TP3
J1
VDISP
D0
D1
D2
D3
D4
D5
D6
D7
DISPCS1*
DISPCS2*
SRST*
WR*
A0
ECLK
LCD Interface
C14
.1uF
R22
0 ohm
BACKLIGHT
E16
E17
E18
E19
E20
E21
RFGND
C9
DNP
J3
NEO_SW
AUD_SW
PAGE_SW
PWRSW
CNTRST_SW
Key Panel Interface
+VBATT
F2
2A SB
J4
THERM
-VBATT
Battery Interface
ALR_1
R15
332
Green
D1
ALR_2
R16
332
Red
VRPY3312X
BAT_1
R18
332
Green
D2
BAT_2
R19
332
Red
VRPG3312X
NEO_LED
R20
332
D3
MPY3371X
BVDD
R21
332
AC_ON
D4
MPG5373X
IC2
93C66
E2CS
SSCLK
SSDO
SSDI
CS
SK
DI
DO
VDD
DC
ORG
GND
C13
.1uF
NOTE:
1.) UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS, 1/8W, 1%
CAPACITANCE VALUES ARE IN FARADS
INDUCTANCE VALUES ARE IN HENRY'S
2.) LAST REF DES USED: C14, D10, E21, F2,
IC2, J4, L8, Q3, R25, TP6,
3.) COMPONENTS NOT USED: C9,R24
L4
F0818-1SR
E9
E10
E4
E12
E5
E11
E1
E13
C02REFIN
C02DATAIN
CGND
+CVA
-CVA
SWMUX
CASETHRM
DETTHRM
J2B
System Interface
L5
F0418-1SR
SSCLK
SSDO
E2CS
SSDI
L7
F0818-1SR
E14
E15
DET HTR RTN
CASE HTR RTN
R24
DNP
R23
0 ohm
R25
0 ohm
R17
0 ohm
E8
RFGND
E7
E6
E3
E2
SRC+
SRC-
DETHTR
CASEHTR
L6
61R30T
L8
61R30T
MODEL 710 INTERFACE BD.
Novametrix
Medical Systems, Inc.
56 Carpenter La.
Wallingford, CT 06492
Drawn: A. Esposito 20 Nov 97
Checked: M.R.L.
Mfg Eng: M.J.C. 17 AUG 98
Approved: A.J.E. 12 AUG 98
Size B
Document Number 2753
Code 03
Rev 01
Sheet 1 of 1
01 Rev.
N631 "R" No.
1/29/99 By Date
File: Model 710 Interface Bd.
Date: Friday, January 29, 1999



NOTES:

1. COMPONENTS NOT FITTED: C150, C165–C178, C180–C202, C220, D39, D44–D49, F2, IC42–IC48, J401, J405, L24, L28–L33, Q23–Q29, R219–R220, R231–R236, R238–R244, R246–R265, R267–R272, R279, R280, R284, R288, VR2
2. FOR TEST PROCEDURE SEE A2754-04.

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DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ± .01 [.254]
.XXX ± .005 [.127]
.XXXX ± .0025 [.064]
FRAC ±1/64
ANG ±1/4°

REV | R NO. | DATE

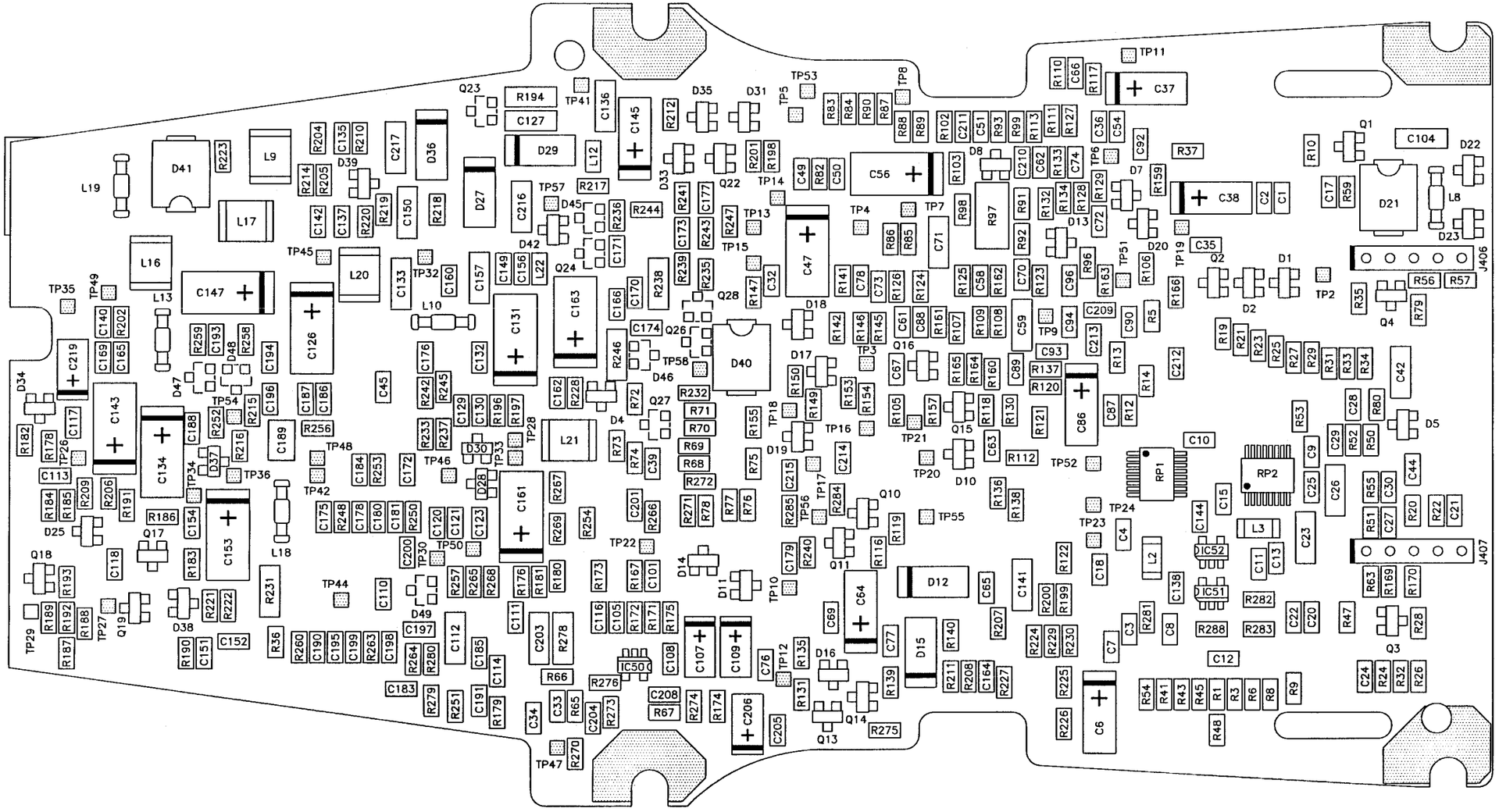
DRAWN Russell G. Griffith DATE 12Mar99
CHECK DATE
MFG ENGR DATE
ENGR DATE
PROJ ENGR DATE 3/19/99
NEXT ASSY: 09425-01

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD ASSY, 615

SIZE	DRAWING NO	CODE	REV
D	2754	01	00

SCALE: 4/1 SHEET 1 OF 3



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DO NOT SCALE
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DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

REV	R NO	DATE

DRAWN Russell G. Griffith 12Mar99
CHECK
MFG ENGR 7/12/99
ENGR
PROJ ENGR 4/21/99
NEXT ASSY D9425-01

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD ASSY, 615

SIZE	DRAWING NO.	CODE	REV
D	2754	01	00

SCALE: 4/1 SHEET 2 OF 3

PN	DESCRIPTION	REF DES
B2739-01	BATTERY & COMM INTERFACE BOARD ASSY	(FOR J406, J407)
2752-02	FAB, MAIN BOARD	~
B2754-03	SCHEMATIC, MAIN BOARD	~
A2754-04	TEST PROCEDURE, MAIN BOARD	~
B6837-10	GASKET, CONNECTOR CRADLE	(FOR 2739-J101)
A9475-07	PROGRAM, FLASH PEROM W BOOT CODE & SYS	IC2
130017	TRANSDUCER, AUDIO, 2300 Hz, 3V, 70mA	LS1
152096	CAPACITOR, 220uF, 35V, 20%, ELECTROLYTIC	C68, C75, C124, C125, C128, C146, C148, C155, C159
154072	CAPACITOR, .1uF, 50V, 10%, X7R	C23, C26, C31, C42, C59, C71, C99, C100, C103, C104, C112, C127, C133, C136, C141, C157, C203
154079	CAPACITOR, 10uF, 25V, 10%, TANTALUM	C6, C37, C38, C64, C86, C102, C145
154081	CAPACITOR, 100pF, 100V, 10%, CERAMIC	C216, C217
154086	CAPACITOR, 4.7uF, 10VDC, 20%, TANTALUM	C107, C109, C206, C219
154093	CAPACITOR, 68uF, 16VDC, 10%, TANTALUM	C47, C56, C131, C153, C158, C161, C163
154095	CAPACITOR, 22uF, 20VDC, 10%, TANTALUM	C126, C147
154103	CAPACITOR, .001uF, 50VDC, 10%, X7R	C51, C139
154104	CAPACITOR, .01uF, 50VDC, 10%, X7R	C25, C41, C48, C49, C54, C60, C66, C70, C72, C74, C77, C78, C81, C83, C85, C92, C96, C105, C108, C114, C118, C140, C162
154105	CAPACITOR, 47pF, 50VDC, 5%, NPO	C90, C94
154106	CAPACITOR, 22pF, 50VDC, 5%, NPO	C27, C30
154108	CAPACITOR, 100pF, 50VDC, 5%, MULTILAYER	C1-C5, C11-C15, C18, C20, C22, C24, C28, C29, C212-C215
154111	CAPACITOR, .1uF, 16VDC, 5%, 1210 CASE	C52, C55, C57, C80, C84, C91, C95
154112	CAPACITOR, .047uF, 16VDC, 10%, X7R	C7-C10, C16, C17, C19, C21, C32-C36, C39, C40, C43-C46, C50, C53, C58, C61-C63, C65, C67, C69, C73, C76, C79, C82, C87-C89, C93, C97, C98, C101, C106, C110, C111, C113, C115-C117, C119-C123, C129, C130, C132, C135, C138, C142, C144, C149, C151, C152, C154, C158, C160, C164, C179, C204, C205, C208-C211, C218
154113	CAPACITOR, 4700pF, 50VDC, 10%, X7R	C137, C207
154116	CAPACITOR, 10uF, 35V, 10%	C134, C143

PN	DESCRIPTION	REF DES
180022	INDUCTOR, 10uH, 10%	L9, L16, L17, L20, L21, L23
180029	INDUCTOR, 50M Hz CUT-OFF FREQUENCY	L2, L3
180030	INDUCTOR-CAP, 4700pF, 50VDC, 2A, 3 TERMINAL	L1, L8, L10, L13, L15, L18, L19
180043	FERRITE BEAD, 30 OHMS @ 100M Hz	L11, L12, L14, L22
180045	INDUCTOR, 220uH, 20%, .53 OHM, 15% DCR	L6, L7
180054	INDUCTOR, 1.5k OHMS @ 100M Hz, 1.5A	L27
☆210141	CONNECTOR, DC POWER JACK	J408
☆211233	CONNECTOR, 2 PIN, HEADER, .079 SPACING	J402
211425	CONNECTOR, 4 PIN, HEADER, STRAIGHT, .1 SP	J403
213900	CONNECTOR, 60 PIN, HEADER, .05 X .1 SPACING	J404
215073	SOCKET, PLCC, 32 PIN, .05 SPACING	(FOR IC2)
☆216029	TEST POINT, SPRING LOADED, 475'C MAX	TP1, TP25, TP31, TP37-TP40, TP43
230024	CRYSTAL, 32.768k Hz	Y1
☆400047	BATTERY, 3V, 190m AH, LITHIUM, VERTICAL	BT1
474194	RESISTOR, 2.2M OHM, 1/16W, 5%	R121, R137
474197	RESISTOR, 49.9k OHM, 1/16W, 1%	R92, R103, R111, R113, R127, R129, R141, R142, R151, R152, R195, R198, R217
474198	RESISTOR, 2.49k OHM, 1/16W, 1%	R108, R109, R125, R126
474199	RESISTOR, 16.5k OHM, 1/16W, 1%	R192
474213	RESISTOR, 10.2k OHM, 1/16W, 1%	R277
474222	RESISTOR, 10 OHM, 1/16W, 1%	R167, R191
474224	RESISTOR, 100 OHM, 1/16W, 1%	R1-R4, R6-R9, R11-R19, R21, R23, R25, R27, R29, R31, R33-R35, R37, R38, R39, R47, R50, R52, R63, R66, R96, R98, R104-R106, R114, R122, R132, R139, R157, R159, R163, R166, R173, R175, R179, R186, R190, R193, R209, R281, R285, R286
474225	RESISTOR, 499 OHM, 1/16W, 1%	R81, R82, R123, R140, R160, R164, R202
474227	RESISTOR, 1k OHM, 1/16W, 1%	R36, R74-R79, R147, R155, R169, R170, R196, R218, R276, R287
474229	RESISTOR, 2.05k OHM, 1/16W, 1%	R62, R203, R205, R206
474230	RESISTOR, 3.32k OHM, 1/16W, 1%	R117, R134
474231	RESISTOR, 4.99k OHM, 1/16W, 1%	R20, R22, R107, R124, R228
474233	RESISTOR, 10k OHM, 1/16W, 1%	R40-R46, R48, R49, R53, R54, R56-R61, R68-R72, R83-R91, R100, R102, R168, R171, R172, R174, R178, R182, R183, R185, R189, R201, R211, R223, R237, R245, R266, R275
474234	RESISTOR, 20.5k OHM, 1/16W, 1%	R115, R133
474235	RESISTOR, 24.9k OHM, 1/16W, 1%	R93, R112, R130, R184, R187

PN	DESCRIPTION	REF DES
474236	RESISTOR, 33.2k OHM, 1/16W, 1%	R118, R136, R188
474238	RESISTOR, 37.4k OHM, 1/16W, 1%	R213
474239	RESISTOR, 75k OHM, 1/16W, 1%	R67, R150, R180, R181, R273
474240	RESISTOR, 100k OHM, 1/16W, 1%	R5, R10, R24, R26, R28, R30, R32, R73, R95, R110, R116, R120, R128, R131, R138, R148, R149, R156, R226, R230
474241	RESISTOR, 150k OHM, 1/16W, 1%	R65, R101, R177, R215, R221, R229
474242	RESISTOR, 249k OHM, 1/16W, 1%	R51
474243	RESISTOR, 324k OHM, 1/16W, 1%	R216, R222
474245	RESISTOR, 1M OHM, 1/16W, 1%	R99, R119, R135, R161, R165, R225
474247	RESISTOR, 10M OHM, 1/16W, 5%	R55
474249	RESISTOR, 215 OHM, 1/16W, 1%	R176
474250	RESISTOR, 43.2k OHM, 1/16W, 1%	R143
474251	RESISTOR, 61.9k OHM, 1/16W, 1%	R94, R204, R274
474256	RESISTOR, 0 OHM, 0603 STYLE	R158, R162, R214, R282, R283
474257	RESISTOR, 1 OHM, .5W, 1%, 2010 SIZE	R97
474259	RESISTOR, 15k OHM, 1/16W, 1%	R80, R146, R154
474261	RESISTOR, 7.5k OHM, 1/16W, 1%	R145, R153
474265	RESISTOR, 1 OHM, 1/4W, 1%	R278
474266	RESISTOR, 4.75k OHM, 1/8W, 1%	R194
474269	RESISTOR, 121k OHM, 1/16W, 1%	R144
474270	RESISTOR, 200k OHM, 1/16W, 1%	R64, R207, R224, R227
474283	RESISTOR, 392k OHM, 1/16W, 1%	R212
474284	RESISTOR, 115 OHM, 1/16W, 1%	R197
474294	RESISTOR, 237k OHM, 1/16W, 1%	R200
474298	RESISTOR, 34k OHM, 1/16W, 1%	R208
474299	RESISTOR PACK, 10k OHM, 15 RESISTOR	RP1, RP2
474332	RESISTOR, 6.04k OHM, 1/16W, 1%	R210
474333	RESISTOR, 210k OHM, 1/16W, 1%	R199
475045	E2 POTENTIOMETER, 10k OHM, 20%	IC32
475052	POTENTIOMETER, 1k OHM, 10%, MULTI-TURN	VR1
481546	DIODE, SWITCHING	D4, D5, D7, D25, D26, D30-D35, D37, D42
481547	DIODE, BAT54, HOT CARRIER SCHOTTKY	D1, D2, D8, D9
481549	DIODE, RECTIFIER	D12, D15, D27, D29, D36, D43
481552	DIODE, SCHOTTKY, 40V, 3A	D21, D40, D41
481554	DIODE, DUAL COMMON CATHODE, 70V	D6, D10, D17, D20
481555	DIODE, DUAL SWITCHING	D11, D13, D14, D16, D18, D19, D22-D24, D28, D38
482551	LED, RED, WITH LENS	D3

PN	DESCRIPTION	REF DES
483019	TRANSISTOR, PNP, SOT-23	Q18
484060	TRANSISTOR, NPN	Q17
484562	IC, MICROPOWER REGULATOR	IC39, IC40
484563	IC, VOLTAGE REGULATOR, ADJUSTABLE	IC35, IC38
484567	VOLTAGE REGULATOR, 35V, 8 PIN	IC36
484569	VOLTAGE REGULATOR, 8 PIN	IC41
484573	VOLTAGE REGULATOR, 150mA	IC49
485532	TRANSISTOR, N-CHAN ENHAN MODE	Q1-Q4, Q7, Q8, Q10, Q11, Q13-Q16, Q19, Q22
485541	TRANSISTOR, MOSFET, DUAL P-CHAN	Q9, Q12, Q20
485543	TRANSISTOR, MOSFET, N-CH & P-CH	Q5, Q6, Q21
486049	IC, 20M Hz, 132 PIN	IC1
486051	IC, 131k X 8 BIT RAM	IC3
486321	IC, 3-LINE TO 8-LINE DECODER	IC12
486346	IC, 2-IN NAND GATE, CMOS, 5 PIN	IC5, IC11, IC51, IC52
486348	IC, 12-STAGE BINARY COUNTER, 16 PIN	IC7
486359	IC, RS232 TRANSCEIVER, 20 PIN	IC26
486360	IC, OCTAL D-TYPE LATCH	IC9, IC10
486785	IC, QUAD VOLTAGE COMPARATOR	IC17
486790	IC, DUAL OP AMP, HI SPEED, LOWER PWR	IC15, IC24, IC27, IC34
486796	IC, DUAL OP AMP, RAIL TO RAIL	IC18, IC20
486805	IC, DUAL VOLTAGE COMP, LOW PWR	IC37
486807	IC, QUAD SAMPLE & HOLD AMP	IC16
486823	IC, RAIL TO RAIL OP AMP, 14 PIN	IC23, IC29, IC31
486825	IC, OP AMP, LOW POWER	IC50
486826	IC, DUAL 12-BIT D TO A CONVERTER	IC33
486827	IC, 12-BIT A TO D CONVERTER	IC6
486828	IC, uPOWER SERIES REF	IC25
486829	IC, DUAL 12-BIT X D TO A CONVERTER	IC22
486830	IC, QUAD OP AMP, LOW POWER	IC21
487100	IC, INV DUAL MOSFET DRVR, 1.2A	IC19
487103	IC, DUAL OD FET DRVR, NON-INV, 1.5A	IC14
487104	IC, DUAL OD FET DRVR, INV, 1.5A	IC13
487115	IC, INSTR AMPLIFIER, L POWER, 8 PIN	IC30
487129	IC, ABSOLUTE PRESSURE SNSR, 15PSI	IC28
487132	IC, SUPPLY VOLTAGE REGULATOR	IC4
487133	IC, REAL TIME CLOCK, 14 PIN	IC8
513010	SWITCH, SLIDE, SPDT, 4 SWITCHES, .050 SPACING	S1
515092	FUSE, 3A, 32V, VERY FAST-ACTING, 1206 STYLE	F1
560009	TRANSFORMER, 10uH 20% @ .1VRMS, 100k Hz	T1

NOTES:

☆ DENOTES THRU HOLE COMPONENTS.

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.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

REV	R NO.	DATE

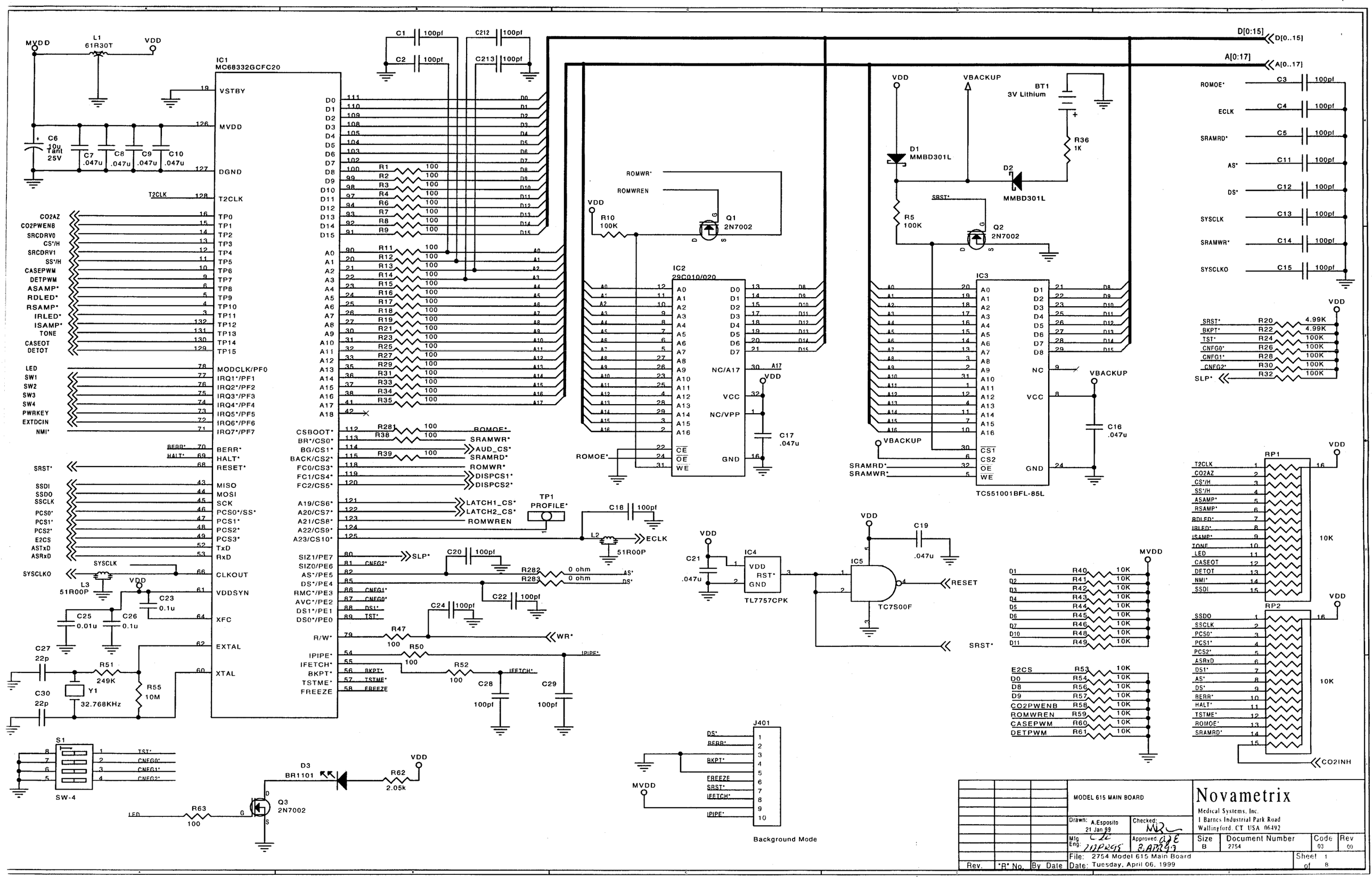
DRAWN Russell A. Griffith DATE 12Mar99
CHECK MKL DATE
MFG ENGR C. Carll DATE 7APR99
ENGR DATE
PROJ ENGR DATE 4/7/99
NEXT ASSY: D9425-01

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD ASSY, 615

SIZE	DRAWING NO.	CODE	REV
D	2754	01	00

SCALE: NONE SHEET 3 OF 3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VDD
IC1
MC68332GCFC20
VSTBY
MVDD
DGND
T2CLK
C6
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Tant
25V
C7
.047u
C8
.047u
C9
.047u
C10
.047u
C1
100pf
C2
100pf
C212
100pf
C213
100pf
D[0:15]
A[0:17]
ROMWR*
ROMWREN
R10
100K
Q1
2N7002
IC2
29C010/020
NC/A17
NC/VPP
VCC
GND
C17
.047u
ROMOE*
D1
MMBD301L
D2
MMBD301L
BT1
3V Lithium
R36
1K
SBST*
R5
100K
Q2
2N7002
IC3
TC551001BFL-85L
SRAMRD*
SRAMWR*
ROMOE*
ECLK
SRAMRD*
AS*
DS*
SYSCLK
SRAMWR*
SYSCLKO
C3
C4
C5
C11
C12
C13
C14
C15
SRST*
BKPT*
TST*
CNFG0*
CNFG1*
CNFG2*
R20
R22
R24
R26
R28
R30
R32
4.99K
4.99K
100K
100K
100K
100K
SLP*
CO2AZ
CO2PWENB
SRCDRV0
CS*/H
SRCDRV1
SS*/H
CASEPWM
DETPWM
ASAMP*
RDLED*
RSAMP*
IRLED*
ISAMP*
TONE
CASEOT
DETOT
LED
SW1
SW2
SW3
SW4
PWRKEY
EXTDCIN
NMI*
BERR*
HALT*
RESET*
SSDI
SSDO
SSCLK
PCS0*
PCS1*
PCS2*
E2CS
ASTxD
ASRxD
SYSCLK
SYSCLKO
MODCLK/PF0
IRQ1*/PF1
IRQ2*/PF2
IRQ3*/PF3
IRQ4*/PF4
IRQ5*/PF5
IRQ6*/PF6
IRQ7*/PF7
MISO
MOSI
SCK
PCS0*/SS*
PCS1*
PCS2*
PCS3*
TxD
RxD
CLKOUT
VDDSYN
XFC
EXTAL
XTAL
Y1
32.768KHz
C27
22p
C30
22p
R51
249K
R55
10M
L3
51R00P
C23
0.1u
C25
0.01u
C26
0.1u
CSBOOT*
BR*/CS0*
BG/CS1*
BACK/CS2*
FC0/CS3*
FC1/CS4*
FC2/CS5*
A19/CS6*
A20/CS7*
A21/CS8*
A22/CS9*
A23/CS10*
SIZ1/PE7
SIZ0/PE6
AS*/PE5
DS*/PE4
RMC*/PE3
AVC*/PE2
DS1*/PE1
DS0*/PE0
R/W*
IPIPE*
IFETCH*
BKPT*
TSTME*
FREEZE
SRAMWR*
AUD_CS*
SRAMRD*
ROMWR*
DISPCS1*
DISPCS2*
LATCH1_CS*
LATCH2_CS*
ROMWREN
TP1
PROFILE*
C18
100pf
L2
51R00P
ECLK
SLP*
C20
100pf
R282
0 ohm
R283
0 ohm
AS*
DS*
C22
100pf
C24
100pf
WR*
R47
100
R50
100
R52
100
C28
100pf
C29
100pf
CNFG2*
CNFG1*
CNFG0*
TST*
SW-4
S1
D3
BR1101
R62
2.05k
Q3
2N7002
R63
100
LED
VDD
MVDD
J401
Background Mode
IC4
TL7757CPK
C21
.047u
IC5
TC7S00F
C19
.047u
RESET
SRST*
C16
.047u
VBACKUP
RP1
RP2
10K
CO2INH
R1
R2
R3
R4
R6
R7
R8
R9
R11
R12
R13
R14
R15
R16
R17
R18
R19
R21
R23
R25
R27
R29
R31
R33
R34
R35
R281
R38
R39
R40
R41
R42
R43
R44
R45
R46
R48
R49
R53
R54
R56
R57
R58
R59
R60
R61
100
10K
Novametrix
Medical Systems, Inc.
1 Barnes Industrial Park Road
Wallingford, CT USA 06492
MODEL 615 MAIN BOARD
Drawn: A.Esposito
21 Jan 99
Checked:
Mfg Eng:
Approved
Size
B
Document Number
2754
Code
03
Rev
00
File: 2754 Model 615 Main Board
Date: Tuesday, April 06, 1999
Sheet 1 of 8
Rev.
"R" No.
By
Date

A[0..17]
D[0..15]
D[0..15]
J404A
60 D0
59 D1
58 D2
57 D3
56 D4
55 D5
54 D6
53 D7
52 ECLK
51
50 WR*
49 SRST*
48 DISPCS1*
47 DISPCS2*
46
45
44
43
42 VDISP
41 BKLGHT_OUT
40 BAT_1
39 BAT_2
38 ALR_1
37 ALR_2
36 NEO_LED
35
34
33
32
31
30
29
28
27 +VCHG
26
25
24
23
22
21
D8 D9 D10 D11 D12 D13 D14 D15
A0
VDD
C32 .047u
+VBATT
VDD
R68 10K
R69 10K
R70 10K
R71 10K
R72 10K
PWRSW
D4
D914
R74 1K
R75 1K
R76 1K
R77 1K
R78 1K
PWRKEY
SW1
SW2
SW3
SW4
ystem Interface

R65 150K
C33 .047u
C203 0.1u
+VA
C34 .047u
IC29B
R67 75K
R273 75K
R66 100
VPUMP
LT1490CS8
C204 .047u

R274 61.9K
IC50
LMC7101
C208 .047u
+VA
R276 1K
R278 1 ohm
J402
Sampling Pump

SSDI
IC6
CO2DATA
CO2REF
CO2ISRC
CO2CASE
CO2DET
ABPRESS
SPO2FEDC
SPO2RDLED
SPO2IRLED
VPUMP
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10
DOUT 16
VBATTADC
R64 200K
C31 0.1u
REF+ 14
REF- 13
ADCCS*
SSDO
CS 15
ADDIN 17
SSCLK
IOCLK 18
EOC 19
CVREF
R37 100
CVDD
C35 .047u
C38 10u Tant 25V
C36 .047u
C37 10u Tant 25V
VCC 20
GND 10
TLC2543DB

IC49
Vout Vin
Gnd
Adj En
+VA
C205 .047u
C206 4.7u Tant 10V
R275 10K
R277 10.2K
VR2 DNP
C207 0.0047u
PUMP_CTRL
MIC5205BM5

IC9
74AHCT573
NEO_LED
BAT_1
BAT_2
ALR_1
ALR_2
COMMPWR
AUD_EN
RTC_WR*
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8
D1 D2 D3 D4 D5 D6 D7 D8
VCC GND C OC
C43 .047u
D[0:15]
C138 .047u
IC10
74AHCT573
SPO2CAL
SPO2SC1
SPO2LPON
INSIG*
SIGND*
POWER_ON
PUMP_CTRL
C44 .047u

VDD
C40 .047u
BACKLIGHT
IC11
TC7S00F
LITE_CLK
C42 0.1u
D5 D914
R80 15K
R79 1K
Q4 2N7002
TP2
BKLGHT_OUT
C41 0.01u

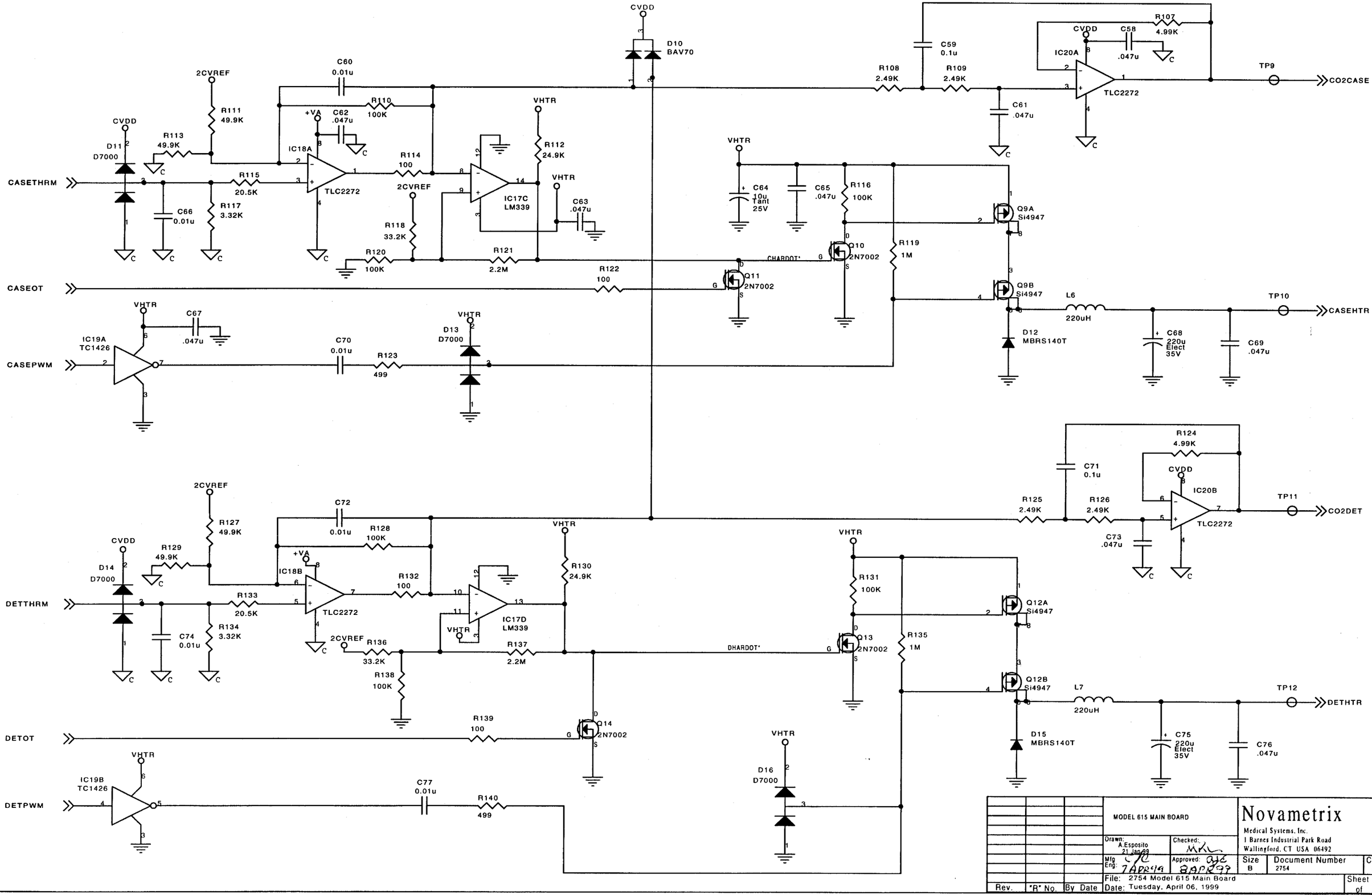
IC12
74HC138
C45 .047u
PCS0*
PCS1*
PCS2*
SRST*
VCC A B C G1 G2A G2B GND
Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7
ADCCS*
CO2DACCS*
SPO2DACCS*
SPO2RDADC*
SPO2IRADC*
RTCCS*
IC51
TC7S00F
LATCH1_CS*
R288 DNP
C144 .047u
IC52
TC7S00F
LATCH2_CS*

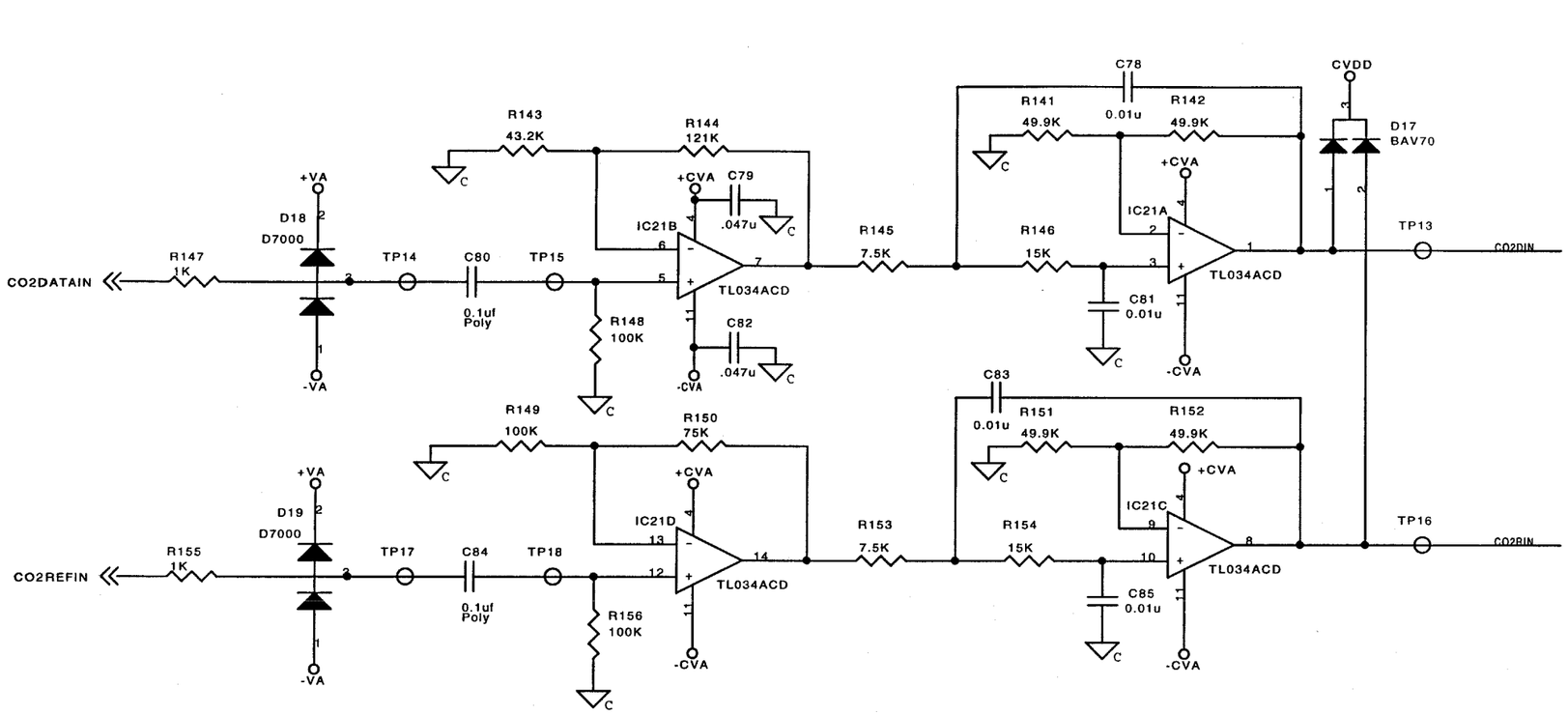
IC8
RTC-4553
GND VDD
WR DOUT
DIN CS1
SCK CS0
TP L1 L2 L3 L4 L5
RTC_WR*
SSDO
SSCLK
SSDI
R73 100K
SRST*
RTCCS*
VBACKUP
C39 .047u

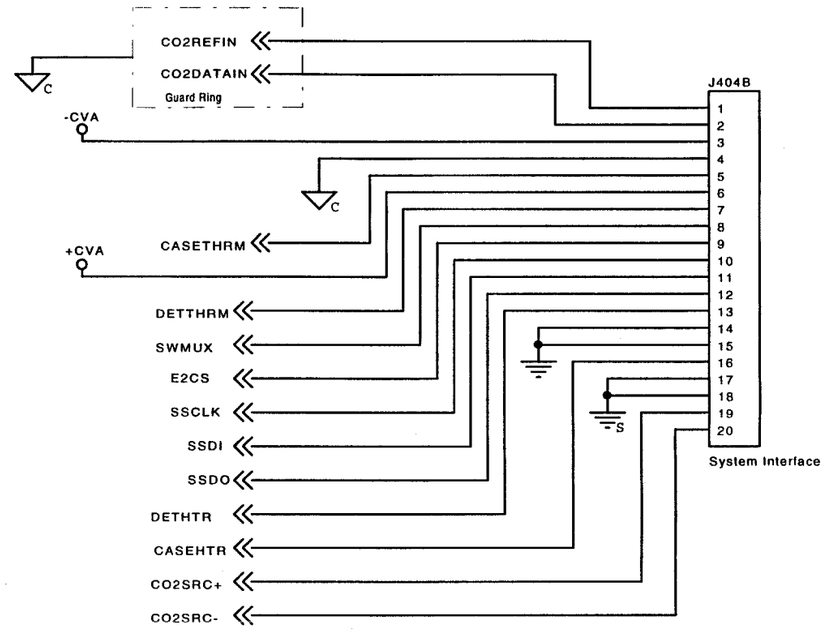
MODEL 615 MAIN BOARD
Novametrix
Medical Systems, Inc.
1 Barnes Industrial Park Road
Wallingford, CT USA 06492
Drawn: A.Esposito 21 Jan 99
Checked: MRL
Mfg Eng: 20APR99
Approved: 20APR99
Size B
Document Number 2754
Code 03
Rev 00
File: 2754 Model 615 Main Board
Date: Tuesday, April 06, 1999
Sheet 2 of 8
Rev. "R" No. By Date

SRCDRV0
SRCDRV1
CO2INH
CO2PWENB
RESET
CO2AZ
CS*/H
R83 10K
R84 10K
R87 10K
R90 10K
R88 10K
R89 10K
R81 499
R82 499
R91 10K
R92 49.9K
R97 1 ohm 1/2W
R102 10K
R103 49.9K
R98 100
R99 1M
R85 10K
R86 10K
R93 24.9K
R94 61.9K
R95 100k
R100 10K
R101 150K
R96 100
R104 100
R105 100
R106 100
C46 .047u
C48 0.01u
C47 68u Tant 16V
C49 0.01u
C50 .047u
C51 1000p
C52 0.1uf Poly
C53 .047u
C54 0.01u
C55 0.1uf Poly
C56 68u Tant 16V
C57 0.1uf Poly
C209 .047u
C210 .047u
C211 .047u
IC13A TC4404
IC13B TC4404
IC14A TC4405
IC14B TC4405
IC15A TLE2022
IC15B TLE2022
IC16A SMP04
IC17A LM339
IC17B LM339
Q5A Si9939DY
Q5B Si9939DY
Q6A Si9939DY
Q6B Si9939DY
Q7 2N7002
Q8 2N7002
D6 BAV70
D7 D914
D8 MMBD301L
D9 MMBD301L
TP3
TP4
TP5
TP6
TP7
TP8
CO2SRC+
CO2SRC-
CO2ISRC
VDD
+VSRC
-VSRC
VHTR
+VA
-VA
+CVA
-CVA
CVDD

			MODEL 615 MAIN BOARD	Novametrix	
				Medical Systems, Inc.	
				1 Barnes Industrial Park Road	
			Drawn: A. Esposito 21 Jan 99	Checked: MRC	Wallingford, CT USA 06492
			Mfg Eng: 7APR99	Approved: 8 Apr 99	Size B / Document Number 2754 / Code 03 / Rev 00
Rev.	*R* No.	By Date	File: 2754 Model 615 Main Board		Sheet 3 of 8
			Date: Tuesday, April 06, 1999		


CVDD
D10
BAV70
C59
0.1u
R107
4.99K
CVDD
C58
.047u
IC20A
TLC2272
TP9
CO2CASE
R108
2.49K
R109
2.49K
C61
.047u
2CVREF
R111
49.9K
C60
0.01u
R110
100K
+VA
C62
.047u
VHTR
R112
24.9K
CVDD
D11
D7000
R113
49.9K
IC18A
TLC2272
R114
100
IC17C
LM339
VHTR
C63
.047u
CASETHRM
R115
20.5K
2CVREF
C66
0.01u
R117
3.32K
R118
33.2K
R120
100K
R121
2.2M
VHTR
C64
10u
Tant
25V
C65
.047u
R116
100K
Q9A
Si4947
CHARDOT*
Q10
2N7002
R119
1M
CASEOT
R122
100
Q11
2N7002
Q9B
Si4947
L6
220uH
TP10
CASEHTR
VHTR
C67
.047u
IC19A
TC1426
CASEPWM
C70
0.01u
R123
499
VHTR
D13
D7000
D12
MBRS140T
C68
220u
Elect
35V
C69
.047u
R124
4.99K
C71
0.1u
CVDD
IC20B
TLC2272
TP11
CO2DET
R125
2.49K
R126
2.49K
C73
.047u
2CVREF
R127
49.9K
C72
0.01u
R128
100K
+VA
VHTR
R130
24.9K
CVDD
D14
D7000
R129
49.9K
IC18B
TLC2272
R132
100
IC17D
LM339
VHTR
DETTHRM
R133
20.5K
2CVREF
C74
0.01u
R134
3.32K
R136
33.2K
R138
100K
R137
2.2M
VHTR
R131
100K
Q12A
Si4947
DHARDOT*
Q13
2N7002
R135
1M
DETOT
R139
100
Q14
2N7002
Q12B
Si4947
L7
220uH
TP12
DETHTR
VHTR
C77
0.01u
R140
499
D16
D7000
D15
MBRS140T
C75
220u
Elect
35V
C76
.047u
IC19B
TC1426
DETPWM
MODEL 615 MAIN BOARD
Novametrix
Medical Systems, Inc.
1 Barnes Industrial Park Road
Wallingford, CT USA 06492
Drawn: A. Esposito 21 Jan 99
Checked:
Mfg Eng:
Approved:
Size B
Document Number 2754
Code 03
Rev 00
File: 2754 Model 615 Main Board
Date: Tuesday, April 06, 1999
Sheet 4 of 8
Rev. "R" No. By Date





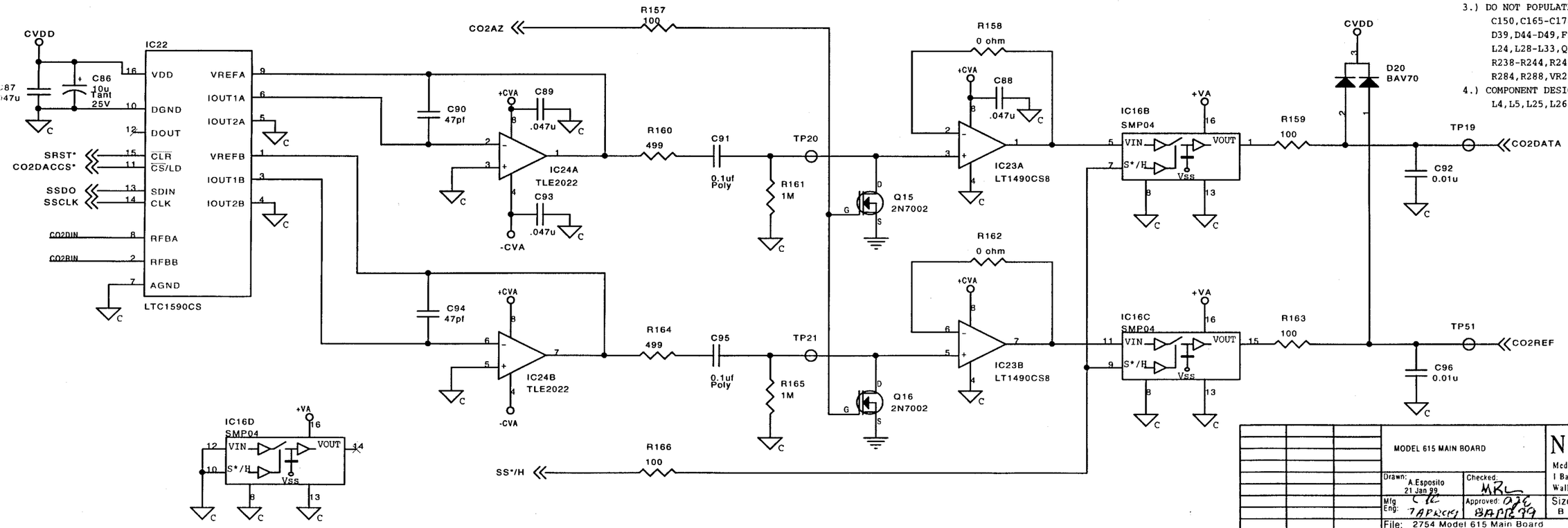
NOTE:

1.) UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS 1/16W, 1%
CAPACITANCE VALUES ARE IN FARADS
INDUCTANCE VALUES ARE IN HENRY'S

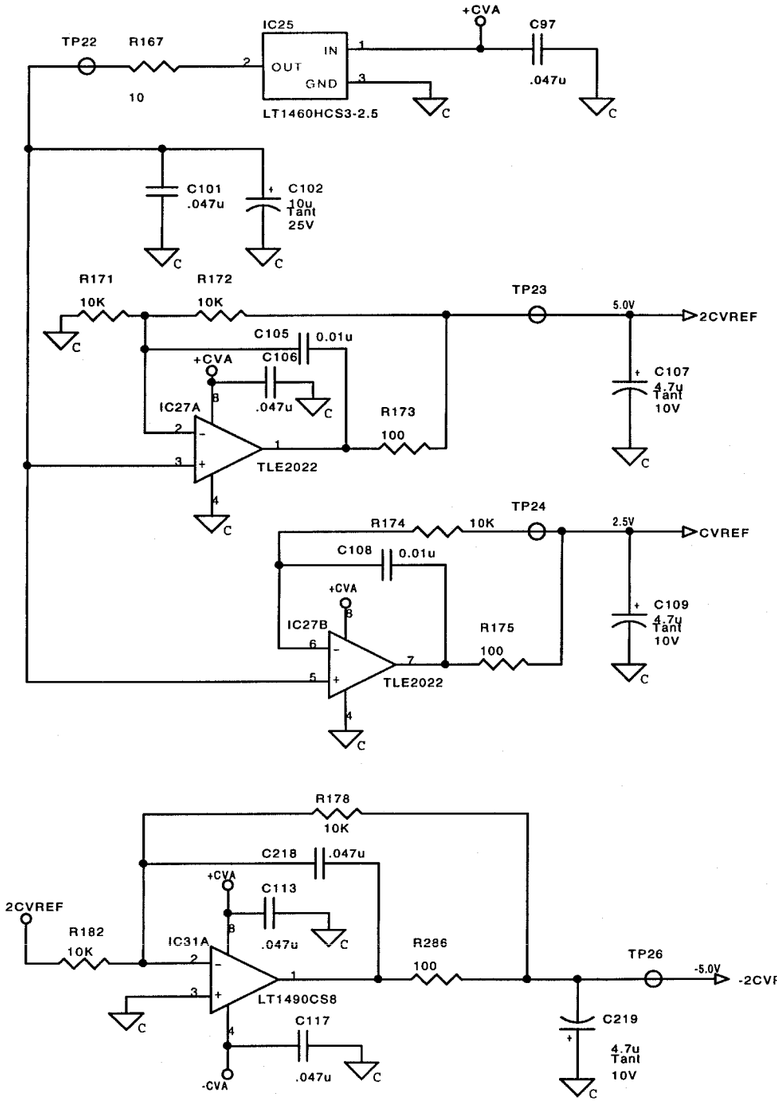
2.) LAST REF DES USED:
BT1, C220, D49, F2, IC52, J408, L33,
LS1, Q29, R288, RP2, S1, T1, TP56,
VR2,Y1

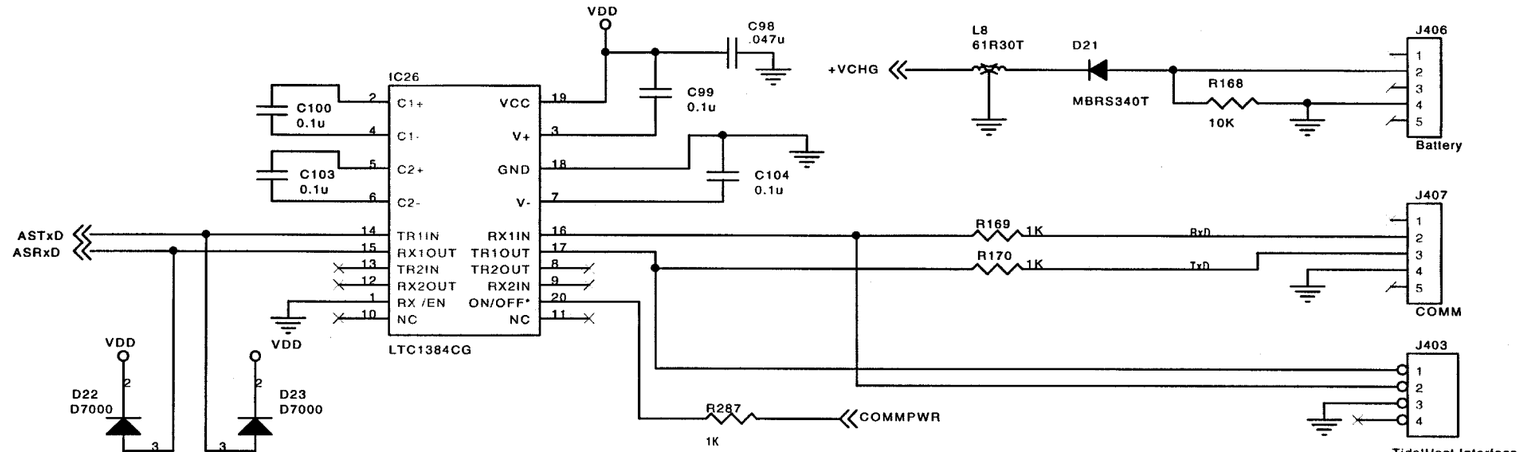
3.) DO NOT POPULATE THE FOLLOWING:
C150,C165-C178,C180-C202,C220,
D39,D44-D49,F2,IC42-IC48,J401,J405,
L24,L28-L33,Q23-Q29,R219-R220,R231-R236,
R238-R244,R246-R265,R267-R272,R279,R280,
R284,R288,VR2

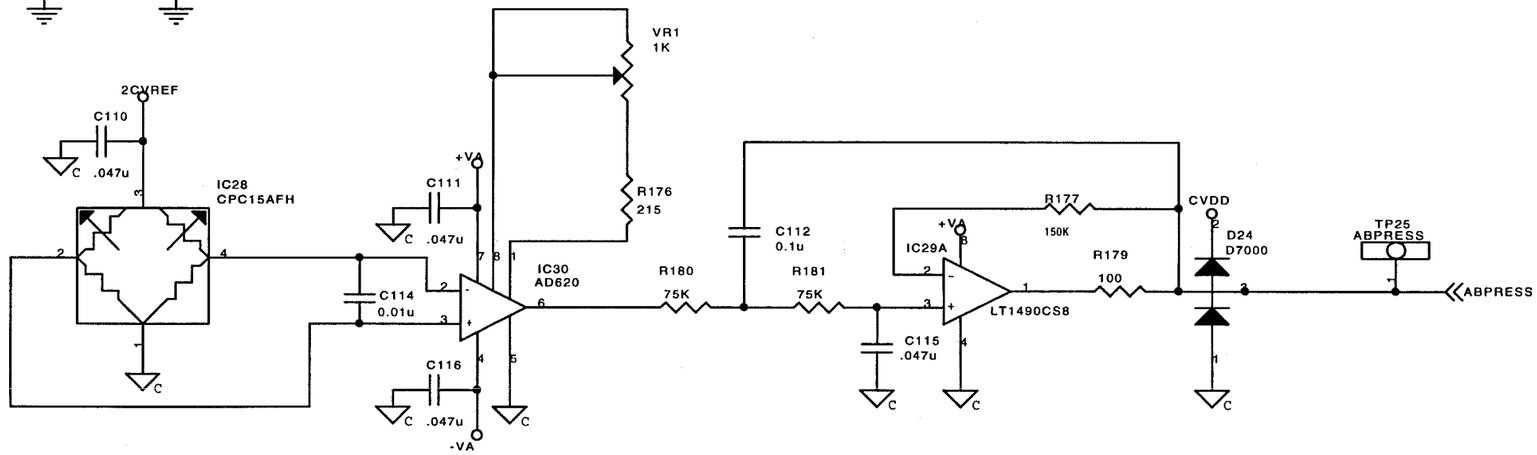
4.) COMPONENT DESIGNATORS NOT USED:
L4,L5,L25,L26

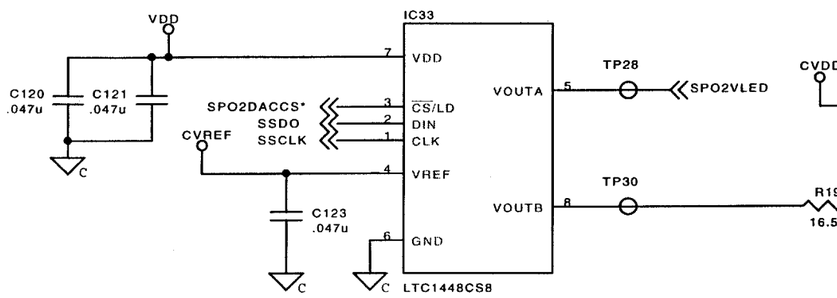


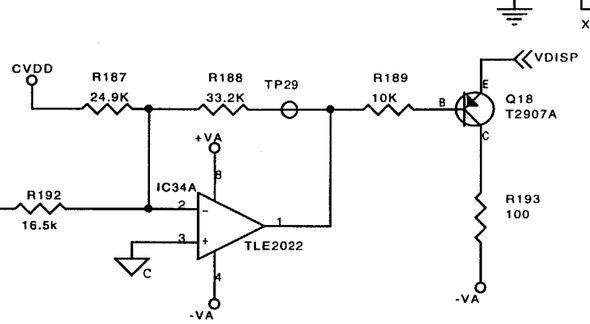
			MODEL 615 MAIN BOARD		Novametrix		
					Medical Systems, Inc.		
					1 Barnes Industrial Park Road		
			Drawn: A.Esposito 21 Jan 99	Checked: MRL	Wallingford, CT USA 06492		
			Mfg Eng: TAPRICH	Approved: BAB 4/6/99	Size: B	Document Number: 2754	Code: 03	Rev: 00
Rev.	"R" No.	By Date	File: 2754 Model 615 Main Board				Sheet 5 of 8
			Date: Tuesday, April 06, 1999				

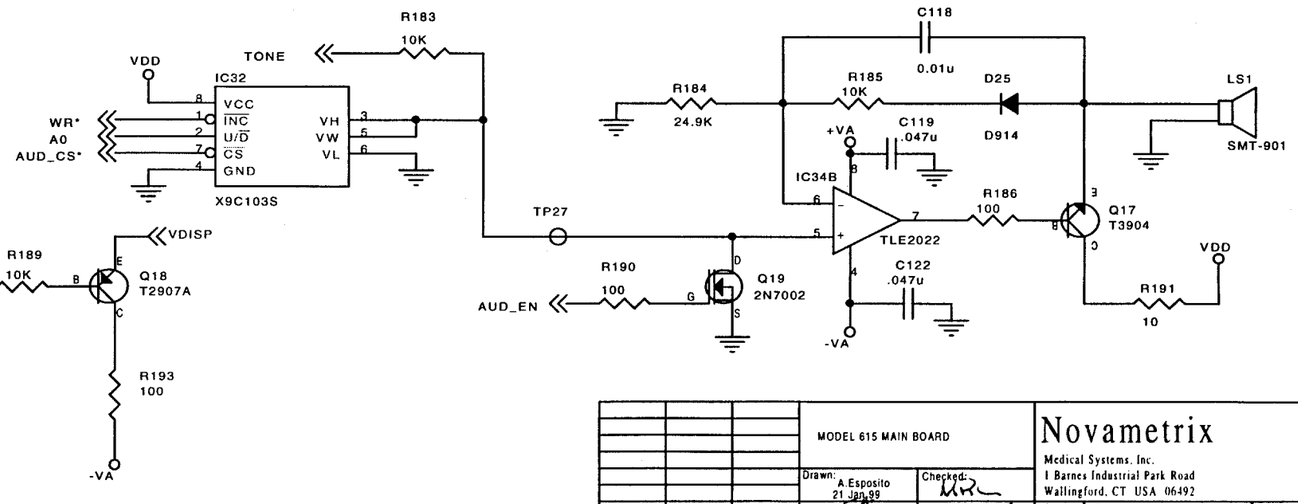












			MODEL 615 MAIN BOARD	Novametrix		
				Medical Systems, Inc.		
				1 Barnes Industrial Park Road		
				Wallingford, CT USA 06492		
			Drawn: A.Esposito 21 Jan 99	Checked:		
			Mfg Eng: TAP 2/19	Approved: WE BARR 99	Size B	Document Number 2754	Code 03	Rev 00
Rev.	"R" No.	By Date	File: 2754 Model 615 Main Board		Sheet 6 of 8	
			Date: Tuesday, April 06, 1999			

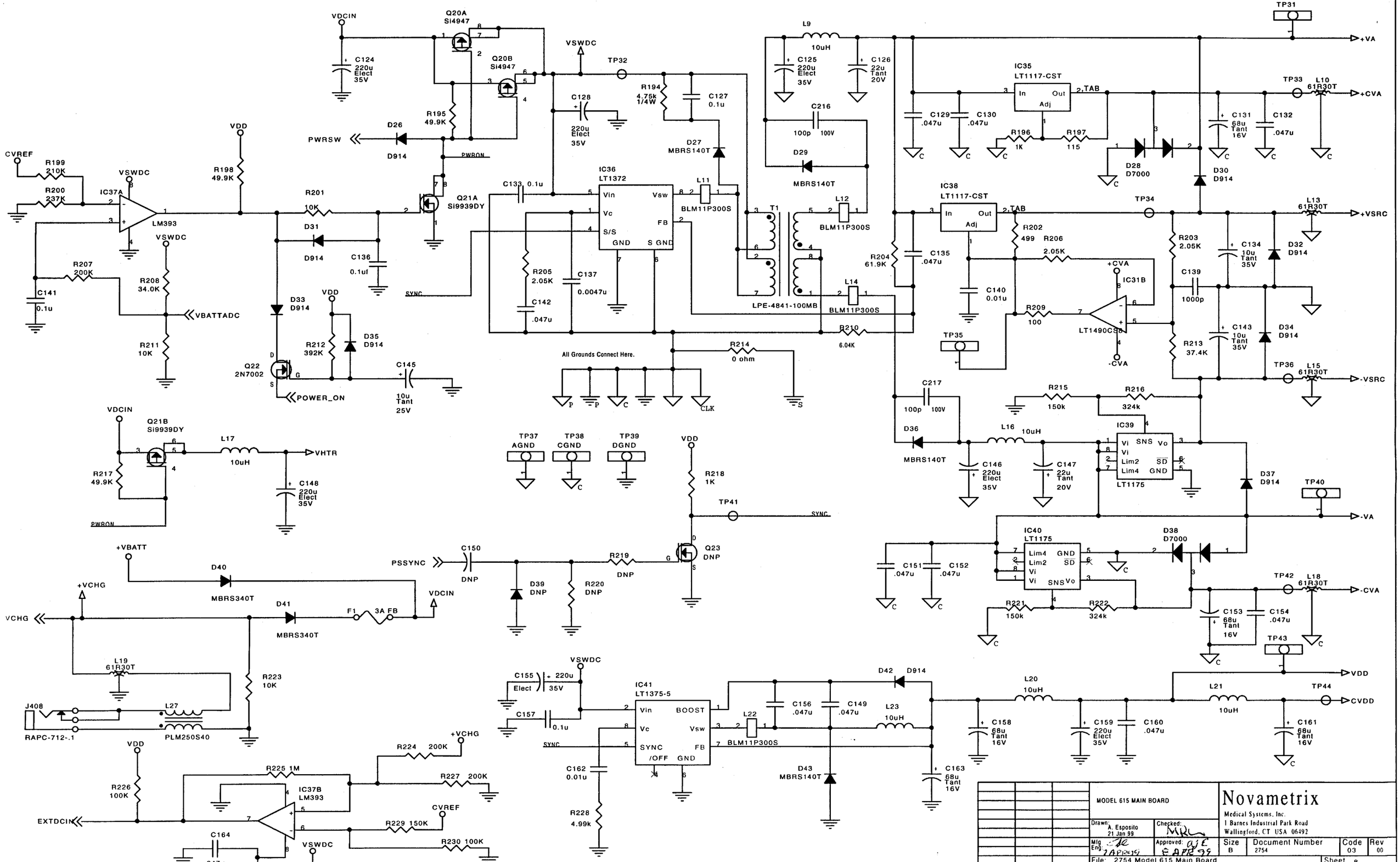
+CVA
F2
DNP
FB
C165
DNP
IC42
DNP
Vi
NC
NC
ADJ
Vo
Vo
Vo
Vo
R231
DNP
L24
DNP
TP45
C167
DNP
Tant
16V
C168
DNP
Tant
16V
C169
DNP
R234
DNP
SPO2LPON
Q25
DNP
D44
DNP
R232
DNP
CVDD
R235
DNP
R236
DNP
R238
DNP
-CVA
IC43A
C166
DNP
C170
DNP
C171
DNP
D45
DNP
Q24
DNP
R233
DNP
SPO2RDLED
R237
10K
C172
DNP
SPO2VLED
TP55
R239
DNP
C173
DNP
Q26
DNP
RDLED*
IRLED*
ISAMP*
PSSYNC
SPO2CLK
655.3kHz
2.62MHz
R240
DNP
R284
DNP
R285
100
C214
100pf
C215
100pf
CLK
R241
DNP
CVDD
R243
DNP
R244
DNP
R246
DNP
IC43B
C174
DNP
D46
DNP
Q27
DNP
R242
DNP
SPO2IRLED
R245
10K
C176
DNP
SYSCLKO
20.97MHz
RESET
IC7
CLK
RST
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
VDD
DGND
74HC4040
C179
.047u
5.12kHz
LITE_CLK
TP56
R247
DNP
C177
DNP
Q28
DNP
L28
L29
L30
L31
L32
L33
DNP
J405
1
2
3
4
5
6
7
C175
DNP
IC44
DNP
SPO2IRADC*
SSCLK
SSDI
SPO2CLK
SLP*
SPO2CAL
SPO2SC1
CS
SCLK
SDATA
CLK
CLKO
SLP
CAL
SC1
SC2
MODE
BP/UP
DGND
AGND
VD+
VA+
VREF
VA-
VD-
AIN
R248
DNP
2CVREF
C178
DNP
CVREF
C180
DNP
-2CVREF
C181
DNP
R250
DNP
C184
DNP
TP46
R253
DNP
C185
DNP
R257
DNP
R251
DNP
R279
DNP
C183
DNP
IC46A
C191
DNP
R254
DNP
C192
DNP
IC47A
DNP
TP54
R252
DNP
IC48B
C189
DNP
R256
DNP
TP47
TP48
IC47B
C186
DNP
C187
DNP
R249
DNP
C182
DNP
IC48A
C188
DNP
D47
DNP
R255
DNP
C220
DNP
R258
DNP
C194
DNP
TP49
C196
DNP
R259
DNP
C193
DNP
D48
DNP
C190
DNP
IC45
DNP
SPO2RDADC*
SSCLK
SSDI
SPO2CLK
SLP*
SPO2CAL
SPO2SC1
R260
DNP
C195
DNP
C197
DNP
C198
DNP
R263
DNP
C199
DNP
TP50
R265
DNP
C200
DNP
R268
DNP
D49
DNP
R264
DNP
R280
DNP
IC46B
R267
DNP
C202
DNP
IC47D
DNP
Q29
DNP
R261
DNP
IC47C
DNP
R262
DNP
R266
10K
C201
DNP
Note: The components labeled DNP on this page are not installed in this version.
RSAMP*
ASAMP*
SIGND*
INSIG*
SPO2FEDC
R269
R270
R271
R272
DNP

MODEL 615 MAIN BOARD

Novametrix
Medical Systems, Inc.
56 Carpenter La.
Wallingford, CT 06492

Drawn: A. Esposito 21 Jan 99
Checked:
Mfg Eng.
Approved:
Size B
Document Number 2754
Code 03
Rev 00
File: 2754 Model 615 Main Board
Date: Thursday, April 01, 1999
Sheet 7 of 8

Rev. | "R" No. | By | Date


VDCIN
Q20A Si4947
Q20B Si4947
C124 220u Elect 35V
VSWDC
TP32
L9 10uH
C125 220u Elect 35V
C126 22u Tant 20V
TP31
+VA
IC35 LT1117-CST
C129 .047u
C130 .047u
R196 1K
R197 115
TP33
L10 61R30T
+CVA
C131 68u Tant 16V
C132 .047u
D28 D7000
D30 D914
R195 49.9K
D26
D914
PWRSW
PWRON
R194 4.75k 1/4W
C127 0.1u
C128 220u Elect 35V
C216 100p 100V
D29
MBRS140T
D27 MBRS140T
VDD
R198 49.9K
CVREF
R199 210K
R200 237K
IC37A
LM393
VSWDC
R201 10K
D31
D914
C136 0.1uf
Q21A Si9939DY
C133 0.1u
IC36 LT1372
Vin
Vc
S/S
GND
Vsw
FB
S GND
L11
BLM11P300S
L12
BLM11P300S
T1
LPE-4841-100MB
L14
BLM11P300S
R210 6.04K
R205 2.05K
C137 0.0047u
C142 .047u
SYNC
R207 200K
C141 0.1u
R208 34.0K
VBATTADC
R211 10K
D33 D914
R212 392K
D35 D914
Q22 2N7002
POWER_ON
C145 10u Tant 25V
All Grounds Connect Here.
R214 0 ohm
P
C
CLK
S
IC38 LT1117-CST
TP34
L13 61R30T
+VSRC
R202 499
R206 2.05K
C135 .047u
R204 61.9K
C140 0.01u
TP35
IC31B
LT1490CS8
-CVA
R209 100
R203 2.05K
C139 1000p
C134 10u Tant 35V
D32 D914
C143 10u Tant 35V
D34 D914
R213 37.4K
TP36
L15 61R30T
-VSRC
C217 100p 100V
D36
MBRS140T
L16 10uH
IC39 LT1175
Vi
SNS
Vo
Lim2
SD
Lim4
GND
R215 150k
R216 324k
C146 220u Elect 35V
C147 22u Tant 20V
D37 D914
TP40
-VA
IC40 LT1175
C151 .047u
C152 .047u
D38 D7000
R221 150k
R222 324k
TP42
L18 61R30T
-CVA
C153 68u Tant 16V
C154 .047u
TP43
VDCIN
Q21B Si9939DY
L17 10uH
VHTR
R217 49.9K
C148 220u Elect 35V
PWRON
TP37 AGND
TP38 CGND
TP39 DGND
VDD
R218 1K
TP41
SYNC
PSSYNC
C150 DNP
R219 DNP
Q23 DNP
D39 DNP
R220 DNP
+VBATT
D40 MBRS340T
D41 MBRS340T
F1 3A FB
VDCIN
+VCHG
VCHG
L19 61R30T
R223 10K
J408
RAPC-712-.1
L27 PLM250S40
VSWDC
C155 220u Elect 35V
C157 0.1u
IC41 LT1375-5
Vin
Vc
SYNC
/OFF
BOOST
Vsw
FB
GND
C156 .047u
C149 .047u
L22
BLM11P300S
L23 10uH
D42 D914
D43 MBRS140T
C162 0.01u
R228 4.99k
C158 68u Tant 16V
L20 10uH
C159 220u Elect 35V
C160 .047u
L21 10uH
C161 68u Tant 16V
TP44
CVDD
VDD
R224 200K
R225 1M
R227 200K
R226 100K
IC37B LM393
CVREF
R229 150K
R230 100K
EXTDCIN
C164 .047u
VSWDC
MODEL 615 MAIN BOARD
Novametrix
Medical Systems, Inc.
1 Barnes Industrial Park Road
Wallingford, CT USA 06492
Drawn: A. Esposito 21 Jan 99
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"R" No.
By
Date